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EDITORS AND PUBLISHERS

HORACE BURRINGTON BAKER
Professor Emeritus of Zoology, University of Pennsylvania

CHARLES B. WURTZ
La Salle College, Philadelphia, Pa. 19141

R. TUCKER ABBOTT
H. A. Pilsbry Chair of Malacology, Academy of Natural Sciences

MRS. HORACE B. BAKER

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No. 1

A NEW CARIBBEAN MURICID MOLLUSK, TYPHIS PUERTORICENSIS

By GERMAINE L. WARMKE, Institute of Marine Biology,
University of Puerto Rico, Mayagüez, Puerto Rico

Recent collections around Puerto Rico have brought to light many interesting and rare mollusks. The total for the island is now well over the 858 species listed in 1961 (Warmke & Abbott) and increases with each dredging expedition.

Recently, the first specimens of the muricid genus *Typhis* were collected by dredging from 33 to 50 fathoms off the west coast of Puerto Rico. These represent a species which is described herein as new.

Family Muricidae, subfamily Typhinae

Genus *Typhis* Montfort, 1810,

subgenus *Talityphis* Jousseaume, 1882

TYPHIS (TALITYPHIS) PUERTORICENSIS, new species.

Plate 1, figs. 1-4

Shell medium-sized, strong, rosy brown when young; later whorls whitish with a brownish-pink cast. Nucleus with two smooth and glassy whorls, followed by 5 gradually increasing whorls each bearing 4 cylindrical tubes alternating with the 4 rounded varices. Varices terminating in thin, recurved hooks. Tubes placed near the preceeding varix, long and backward-pointing before breaking (Plate 1, fig. 2). Whorls parted by an increasing deep suture which is irregularly fluted by upper ends of recurved varices and bases of tubes. Surface sculptured with weak spiral cords that are more prominent on the varices, 6 being visible on the outer lip. Aperture small, oval, smooth internally; varix at outer lip greatly expanded and of nearly uniform width throughout. Suture line between outer lip and unsculptured pad above aperture making a 45-degree angle with the sculpture of the outer lip (Plate 1, fig. 3). Anterior canal long, slender, closed in front; pillar with remnants of three antecedent canals. Operculum unguiculate, with an apical nucleus.

Animal small, light-cream colored, with scattered yellow and

opaque white spots. Foot broad; tentacles long and narrow; eyes tiny black specks at the outer upper half of tentacles, which become thin filaments above the eyes.¹

Holotype: Stanford University Paleo. Type Coll. no. 9722. Adult, length 17.2 mm.; greatest width 10.0 mm.; aperture 4.0 mm.; longest tube 4.5 mm.; dredged alive in 33 fathoms off Punta Cadena, North of Mayagüez, on the west coast of Puerto Rico, from the vessel "Shimada", May 10, 1963.

Paratype: U. S. National Museum No. 635750. Young, length 13.7 mm.; greatest width 7.0 mm.; aperture 4.0 mm.; longest tube 2.9 mm.; dredged alive in approximately 50 fathoms off Punta Cadena, Puerto Rico, from the vessel "Carite", September 14, 1963, bottom sandy-mud and dead shells.

Remarks: Aguayo and Jaume (1947) listed 4 recent species of *Typhis* from the Caribbean. The species and their distributions are: *Typhis* (*Pterotyphis*) *fordi* Pilsbry, 1943, Florida to Cuba; *Typhis* (*Talityphis*) *expansus* Sowerby, 1874, Santo Domingo; *Typhis* (*Siphonochelus*) *longicornis* Dall, 1888, Florida to the Antilles (127-410 fathoms); *Typhis* (*Tripterotyphis*) *cancellatus* Sowerby, 1841, Antilles. *T. cancellatus* also was listed from the Caribbean coast of Panama by Olsson and McGinty (1958).

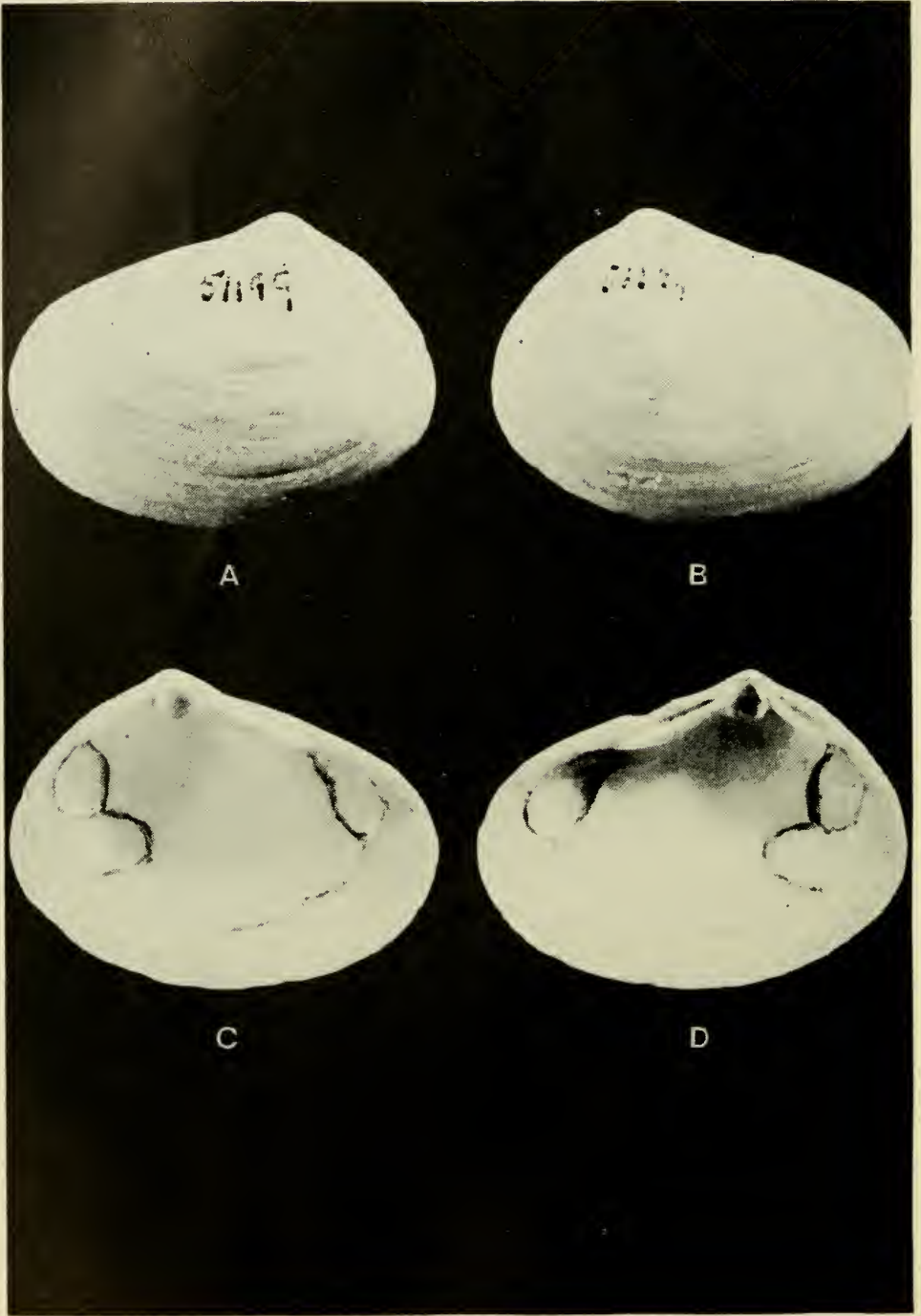
The new species belongs to the subgenus *Talityphis* (adopted from Keen, 1944), which is characterized by the presence of 4 tubes per whorl, the tubes being free and nearer the preceding varix, and the lip of varix of nearly uniform width throughout. Of the species previously reported from the Caribbean, only *Typhis expansus* belongs to the subgenus *Talityphis*.

Diagnosis: Compared to *T. expansus*, the new species is proportionately more slender; the varices are rounded in *T. puertoricensis* (fig. 4), whereas in *T. expansus* the varices are thin and laminar. Another difference is the position of the suture line between the outer varix and the unsculptured pad above the aperture. In *T. expansus* this suture lies at right angles to the top of the aperture; in *T. puertoricensis* the suture makes a 45-degree angle with the sculpture of the outer lip (fig. 3); the

¹ The adult specimen remained alive in an aquarium for several weeks. My observations on the morphology of its foot, tentacles and eyes are different from those that Baker (1895:181) reported for the genus: "... foot long and narrow, tentacles thick and broad; eyes situated at their base." Perhaps Baker's observations were made from preserved material.



Typhis puertoricensis Warmke. Figs. 1 & 2, paratype, length 13.7 mm. 3 & 4, holotype, adult. 4, enlarged to show nuclear whorls and shapes of varices.



Mesodesma arctatum (Conrad). Lectotype, A.N.S.P. 51199. A, exterior of left valve. B, exterior of right valve. C, interior of left valve. D, interior of right valve.

area above the aperture thus seems less flaring.

I wish to express my gratitude to Dr. John E. Randall, Director of the Institute of Marine Biology, who spared no effort to help with this project; to Dr. Myra Keen of Stanford University for assistance and advice; to Dr. Axel A. Olsson for the loan of the *Typhis expansus* specimens which he collected in Santo Domingo; to Dr. Harald Rehder, U. S. National Museum, for the loan of *T. longicornis* and *T. cancellata*; to Dr. Robert Robertson, Academy of Natural Sciences of Philadelphia and to Dr. Kenneth Boss, then at Harvard, for sending copies of original descriptions that were not available to me; and to Dr. Frank G. Lowman, of the Puerto Rico Nuclear Center, for use of the vessel "Shimada."

LITERATURE CITED

- Aguayo, C. G. and Jaume, M. L. 1947. Catálogo Moluscos de Cuba, no. 110, 1 p. (mimeographed).
Baker, Frank C. 1895. Preliminary outline of a new classification of the family Muricidae. Chicago Acad. Sci. Bull. 2 (2):169-189.
Keen, A. Myra. 1944. Catalogue and revision of the gastropod subfamily Typhinae. Jour. of Paleon. 18 (1):51-72.
Olsson, Axel A. and McGinty, T. L. 1958. Recent marine mollusks from the Caribbean Coast of Panama with the description of some new genera and species. Bull. Amer. Paleon. 39 (177):1-58.
Warmke, G. L. and Abbott, R. T. 1961. Caribbean Seashells. 346 pp., Livingston Publishing Company, Narberth, Pennsylvania.

LECTOTYPE DESIGNATION FOR *MESODESMA ARCTATUM*¹

By JOHN D. DAVIS

Department of Zoology, Smith College

Mesodesma arctatum (Conrad) is relatively uncommon along the Atlantic coast of North America, yet occasionally it occurs in great numbers at scattered localities. Largely ignored, this bivalve nevertheless presents some interesting questions in taxonomy and distribution. While attempting to clarify and answer some of these questions through the study of museum collections, I discovered that the specimens used by Conrad in making his original description could no longer be found in the Academy of Natural Sciences of Philadelphia, their original depository.

¹ Contribution no. 247 from the Smith College Department of Zoology.

However, records indicated that one group of shells of *M. arc-tatum* in the collection of the Academy had originally come from Conrad's collection. Although there was no evidence to indicate that any of these specimens were used by Conrad in making his original description, it seemed desirable to designate a lectotype and paratypes using this group of shells.

The following synonymy has been established:

MESODESMA ARCTATUM (Conrad) Plate 2, figs. A-D

Macra arcata Conrad 1831, Jour. Acad. Nat. Sci. Philadelphia 6:257, pl. 11, fig. 1 (Massachusetts) .

Ceronia arcata (Conrad), H. and A. Adams, 1857, The Genera of recent Mollusca, London 2:414.

Using the name *Macra arcata*, Conrad originally described the species in this manner:

"1. *M. arcata*. Plate XI, fig. 1. Shell subovate, solid, compressed, anterior side short, truncated and somewhat angular; posterior side produced, with the end margin rounded; cartilage pit triangular and profound; posterior lateral tooth elongated, and crossed by regular elevated striae.

Inhabits Massachusetts.

Cab. Academy, No. 840. I. Lea, D. B. Smith.

This shell somewhat resembles in shape the *M. donacia*, Lam. The specimens in the Academy's collection were obtained on the coast of Massachusetts, by Dr. C. Pickering."

A careful search of the records and collections of the Academy of Natural Sciences of Philadelphia has failed to produce evidence of specimens deposited under the number 840. Presumably, therefore, either the original shells have been lost or cannot be traced because of the assignment of new numbers.

One group of valves, designated "*Ceronia arcata* Conr., Massachusetts, Ex. Auct., no. 51199," was found in the collection of the Academy. There was no indication whether or not these valves were the specimens originally described by Conrad. In any case, a lectotype was designated in this group of shells which all are considered syntypes or paratypes. There are 7 valves in the group, 3 obvious pairs and one single left valve. The pair selected as the lectotype most clearly resembles the figure published with the original description. The lectotype has retained the original number indicated above, but the paratypes have been recatalogued under no. 290263 of the Academy of Natural Sciences of Philadelphia.

The lectotype of *Mesodesma arctatum* (Conrad) consists of paired right and left valves, length 25.2 mm., height 18.0 mm. (Plate 2, figs. A-D). The beaks or umbones are posterior, lending a truncate appearance as the posterior edge plunges sharply from the beaks to the ventral margin. (Note Conrad's mistake; he described the anterior end as truncate.)

The valves are triangular or wedge-shaped, the posterior edge being the shortest, the dorsal edge somewhat longer and the rounded ventral edge the longest. The dorsal and ventral edges meet at the rounded anterior end. The concentric lines of growth spreading outward from the beaks are visible but not particularly prominent in this specimen. There is no evidence of the external yellow periostracum usually covering shells of this species, indicating this specimen was probably subject to considerable abrasion. This may also account for the relatively smooth outer surface of these two valves. Most living specimens are considerably rougher.

There is a small piece about 2.2 mm. long missing from the dorsal margin of the right valve above the anterior portion of the anterior lateral groove. There is also a slight chip in the posterior margin of the left valve adjacent to the posterior lateral tooth.

The medial side of each umbo possesses a large cartilage pit or chondrophore. The left valve has two lateral teeth. One of these, the anterior, extends forward from the chondrophore adjacent and parallel to the dorsal margin. The posterior lateral tooth extends posteriorly from the chondrophore adjacent and parallel to the posterior margin. It is shorter than the anterior lateral tooth. Each is equipped with many small vertical ridges on both sides. The right valve has two deep, similarly ridged, lateral grooves in position to receive the lateral teeth of the opposite valve.

The pallial line is complete and includes a shallow U-shaped sinus posteriorly. The anterior adductor muscle scar is shaped with an anterior convex side and a posterior concave side. The posterior adductor muscle scar is nearly spherical except for a small dorsal portion near the margin, set off by an indentation on the anterior side of the scar.

The paratypes in lot A.N.S.P. 290263 can be described briefly: One pair of matching left and right valves 36.2 mm. long and

25.5 mm. high. Concentric growth ridges are pronounced. A thin border of periostracum persists along the posterior and ventral margins. Small parts of the postero-ventral margin have been chipped away, especially on the left valve.

One pair of matching left and right valves 29.6 mm. long and 20.0 mm. high. Concentric ridges are fairly pronounced but less than in the preceding pair. The holdfasts of aquatic plants are attached at several places on the exterior. This pair of valves is considerably less truncate posteriorly than the others in the group.

One left valve 21.5 mm. long and 14.0 mm. high. Concentric growth ridges are much reduced and the exterior is rather smooth and polished. A crack extends from near the mid-point of the dorsal margin to below the middle of the valve. The valve is white or chalky without periostracum.

In the original description, Conrad identified the locality of the shells as "the coast of Massachusetts." As noted previously, the lectotype and paratypes are described as coming from Massachusetts. It seems desirable to restrict this broad designation and indicate a specific locality known to support an extensive population of *M. arctatum*. Therefore, Plum Island, near Newburyport, Massachusetts, is designated as the type locality. Supported by the Essex Institute and the Boston Society of Natural History, much past conchological work has centered in the north shore area. Inasmuch as Plum Island is in this area, it probably figured prominently in early study of *Mesodesma arctatum*. For this reason, this site was selected.

Appreciation is expressed to Dr. William J. Clench for reading the manuscript and for his helpful suggestions. I also wish to thank Drs. R. Tucker Abbott and Robert Robertson for making the collections and records of the Academy available to me.

GROWTH RATES IN *ACHATINA FULICA* BOWDICH

BY YOSHIO KONDO

Bishop Museum

The growth rates involving the measurements of length, width, and whorl increase, of 5 *Achatina fulica* individuals were compiled weekly from infancy to adulthood between March 26, 1956, and May 6, 1957. Duration: 1 year, 1 month, 10 days or 406 days.

The study was undertaken purely for self-interest (for fun),

with no thought at that time about the publication of results. A limited review of recent literature discloses that no parallel study has been published.

Lang (1950) gave the measurements of shells raised on Guam by Daniel B. Langford as follows: 5 mm., 8, 12, 26, 34, 40, 63 mm., each figure representing the length of the shell for each succeeding week. For 6 of these weeks the increases are: 3 mm., 4, 14, 8, 6, 23 mm.

Rees (1950) plotted the growth curves of three broods of *A. fulica hamillei* Petit in scattergrams. The approximate period, in days, and the dimensions of the longest specimens are as follows: brood 1: 70-26 mm. x 17; brood 2: 29-22 mm. x 16; brood 3: 16-12 mm. x 9.5. The scattergrams for the first two broods show this interesting phenomenon: there are a few fast growers, and a few laggards interspersed by a large median cluster. The smallest eggs were removed from the third brood and the growth of the remainder plotted, giving an artificial picture.

Data most relevant to this growth study are summarized in table 1.

TABLE 1

	Ghose	Lang	Mead	Mohr
Eggs				
No./brood	27-356	93-184	56-252	82-315
Average/brood	200	139	144	
Size	5.5mm x 4	5 x 4	5 x 4	5.4x4.28
Minimum	3.5 x 3			
Frequency	1 brood/yr			
Total lifetime				1,000
Fertility				80%
Incubation period	1 or 2 da	6-12	2-15	1-10
Egg laying season	July-Sept	July-Nov		
Sex maturity				
Smallest	59mm x 27	147 da		80mm
Average	End 1st yr	2.25"-3.5 7-7.5 whs	7-7.5 whs	
Growth rate	67mm x 34 in 8 mo	5mm-63 in 7 wks		
Longevity			5-6 yrs	
Self fertilization	Proven			Observed
Aestivation	Nov-June			
Whorls				
25 da		2.5-4		
60		5.0		
156		5.5-6.5		

Summary of this tabulation, utilizing Ghose as a yardstick, is as follows:

Achatina fulica lays from 27 to 356 eggs per clutch once a year. The first clutch is the smallest; each clutch increases in number in the second and third years; the number declines in the 4th and 5th years. Average per clutch is 200 eggs. Average size of normal eggs is 5.5 mm. \times 4. Small eggs, constituting an average of 2.5%, are 3.5 \times 3. Total per lifetime is 1000 and fertility 80% (Mohr). Incubation period is between 1 and 15 days. Egg laying season coincides with the wet or rainy season, July to September.

Sex maturity is reached at the end of the first year. The smallest sexually mature specimen was 59 mm. \times 27. Lang gives three criteria for sexual maturity: 147 days, 7 to 7.5 whorls, and 2.25 to 3.5 inches (57 mm. - 88 mm.); Mohr, 80 mm.

Growth rates are not well known. Ghose gives 67 mm. \times 34 in 8 months; Lang, 58 mm. in 7 weeks.

Self-fertilization is evidently a proven point; copulation occurs but is apparently an unnecessary function in reproduction. Fertilization probably takes place in the basal ovotestis duct (Ghose, 1960, p. 92).

Aestivation occurs between November and June.

Longevity is another unsettled point. Mead cites 5 to 6 years.

Whorls in relation to growth are given by Lang, 6.5 in 156 days.

Material and Method. A clutch of about 50 eggs was hatched on or about March 22, 1956. The infants were first seen on March 26. Mensuration commenced immediately, discounting those lost 3 to 4 days.

Ten infants were individually segregated in vials with a piece of lettuce leaf and sealed off with a plug of cotton. These vials were kept in the humid cage with the remainder of their siblings. Individual segregation was for the purpose of (a) observing self-fertilization, if any, and (b) to make simple mensuration of length, width, and number of whorls every seven days.

Two weeks after incarceration, only 5 experimental snails remained (#1, 4, 8, 9, 10); the other 5 crawled under the cotton plug and got lost among their free siblings within the cage.

Vials were changed for larger jars as the snails grew and when they were between 61 and 64 mm. long, the 5 were transferred to wooden cages with a glass top, 8" \times 9" \times 12.5", containing

moist soil 2" thick. At this time, # 8 and 9 were paired in one box while #1, 4, and 10 were isolated individually. The paired snails (#8 and 9) were to be controls.

Food and Water. Lettuce leaves were the snails' daily fare, variegated by an occasional piece of head cabbage, carrot, apple, papaya, banana, omelette, a local fungus called *pepeiao akua* (*Auricularia polytricha*), and *Achatina* shells for lime. Head cabbage was nibbled and so were carrot and apple. They liked the occasional omelette but ignored the fungus. In descending order, the food preference seemed to be: lettuce, papaya, banana, omelette, apple, carrot, head cabbage, fungus. Water was obtained from food. It is interesting that, with a nearly monotonous diet of chiefly lettuce, the 5 shells became large and heavy.

Environment. The cages were purposely kept covered with heavy glass tops at all times, primarily to keep the humidity within at a high level and secondarily to prevent escape. The humidity kept the snails in continuous activity during their rapid growth period. The only incidences of premature aestivation prior to their final aestivation in maturity were those of #9 and 10 when they were a month old (17 mm.), for a period of three to four days.

The approximate average room temperatures for the period of growth were: March 75° F; April, May, June, 80°; July 85°; August 87°; September 85°; October 82°; November 80°; December, January, February, 75°.

The average room humidity ranges from 55% to 75% throughout the year with an occasional 80 to 85% rise after heavy rains during southerly weather for a day or two. This probably has no relation to the internal environment of a moist cage.

Sanitation was practiced to this extent: All garbage was removed regularly and the soil exchanged for new clean soil regularly.

Measurements. When the snails were very small, they were measured against a millimeter ruler under a low power dissecting microscope. While they grew longer, a vernier caliper and then a cranium caliper were used but were found unsatisfactory. A sliding ruler was devised after that. This ruler blocks off the extremes of length and diameter in relation to their horizontal and lateral axes and procures accurate measurements.

Acknowledgement. Miss Setsuko Nakata of the Entomology

Department carried on the measurements after I left for the Philippines on January 7, 1957, thereby deserving half of the credit of this study.

RESULTS

The results are summarized in the 2 accompanying tables and in the 3 graphs. To obviate cluttering the graphs, 3 individuals were plotted for length (#1, 4, 8), two for diameter (#1, 4), and one for whorl age (#1). Three gratuitous pieces of information are also plotted, namely, (bottom graph) the periods of aestivation, (top graph) lateral growth of the lip, and (top graph) loss of weight during inactivity followed by aestivation (small sample only).

TABLE 2

Spm.No.	From:			To:		
	Lgt.	Diam.	Whs.	Lgt.	Diam.	Whs.
4	5mm	4.7	2.5	129	63	8.5
1	6	5.0	2.7	116	60	8.5
9	5	4.5		115	57	8.5
10	5	4.5	2.5	112	57	8.5
8	5	4.7		110	56	8.5

TABLE 3

	1956										1957				
	Mar	Ap	May	Je	Jl	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Ap	May
Plots	26	30	28	25	30	27	24	29	27		2	14	20	18	6
No.days	35	28	28	35	28	28	35	29		35	43	35	29	18	
Spm.No.															
4	5mm	18	37	63	92	107	115	118	125		128	129	129	129	129
1	6	18	38	63	94	106	110	111	111		114	116	116	116	116
9	5	17	40	64	92	102	107	112	113		114	115	115	115	115
10	5	16	39	62	91	103	106	107	110		110	112	112	112	112
8	5	18	37	61	91	101	103	106	108		109	110	110	110	110

A summary of the growth picture is shown in table 2. Mensuration was made every 7 days. The transfer of the data to the graph was simplified to a month by month plotting (28, 29, 35 & 43 days per month). A tabulation of the monthly data is shown in table 3.

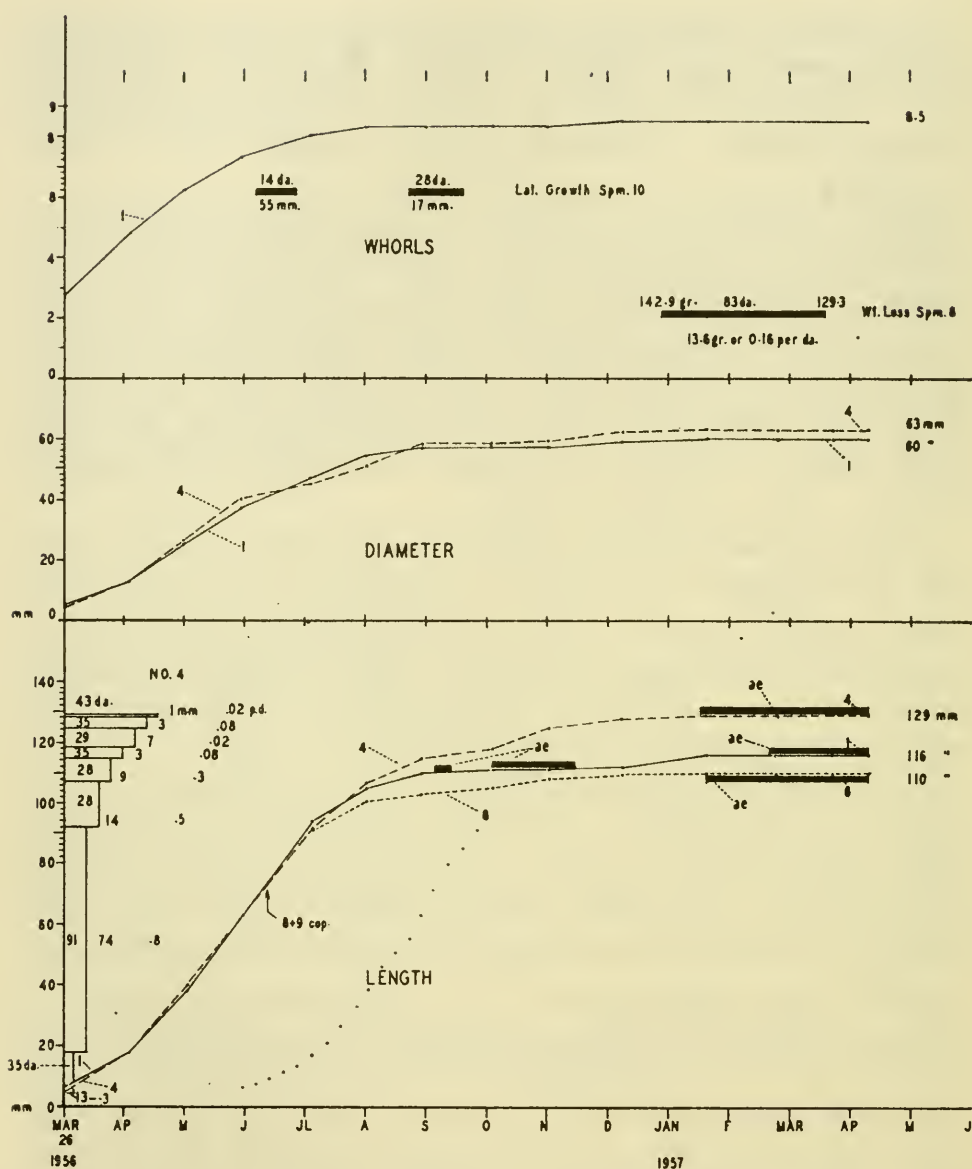
Bottom Graph. In the bottom graph, is pictured the length mensurations of specimens #1, 4, and 8. Aestivation (ae) period(s) are plotted by dark horizontal bars. Beside the mm. scale to the left is an inverted pyramid which summarizes the data for #4 specimen for: (a) growth in mm. for each one of the 8 peaks of growth (internode), (b) the number of days per inter peak (node), and (c) the quotient derived from the formula $\text{length} \div \text{days} = \text{length per day}$.

At the left hand bottom corner is a series of 5 numbers which may be confusing so we should get them out of the way. Clock-wise: Number 1 points to solid line for specimen #1; number 4 to a dashed line for specimen #4; 0.3 is the quotient for the pyramid's apex; number 13 means 13 mm., the length of the apex of the pyramid; 35 da. means days.

The dotted line running through the word "length" is the weekly plot of specimen #1 which proves that the conspicuous infant stage is not an artifact created by the monthly plotting of the growth. The weekly dotted plotting is offset to the right purposely and does not mean that the growth begins at June 25th.

LENGTH. *Infant growth, No. 4.* Specimen #4 begins at 5 mm. on March 26, 1956, and reaches 13 mm. in 35 days. This may be called the infant growth. It is characterized by a relatively slow growth of 0.3 mm. per day for the first 35 days. The other specimens (#1 and 8 plotted; 9 and 10 not plotted) follow the same lengthening procedure. This period may be taken as a normal and expectable pattern of growth in *A. fulica*. The monthly plot seemed to give a conspicuous upswing at this point so a weekly plot was instituted for #1 to test it for artificiality. The dotted partial plot for 17 weeks shows that there is a definite upswing at that point, indicating accelerated metabolism and collateral speedup in growth.

Adolescence, #4. The curve for specimen # 4 takes a steep rise (April 30 to May 28). In a period of 91 days, it grows 74 mm. lengthwise, averaging 0.8 mm. per day. At this point, #4 is



92 mm. long. Before the 5 test snails reached the peak of adolescence, numbers 8 and 9 copulated (8 + 9 cop.) when they were 105 days old (3 months, 13 days), are 77 mm. long, and have 7.6 whorls. The two (#8 and 9) had been paired since they had reached 61 and 64 mm. respectively while the other 3 (#1, 4, 10) were caged solo.

Young Adult, No. 4. After reaching 92 mm., #4's growth rate begins to level off in (generally) ever decreasing steps as shown by the inverted pyramid: 28 days, 28, 35, 29, 35, and finally 45 days. The daily average growth begins to drop rapidly from

0.5 mm. to .02 per day in the final stage.

Maturity. Shell maturity appears to be attained about February 14, 1957, at the age of 324 days (11 months, 10 days).

Sexual maturity was undeterminable in this experiment because no viable eggs were laid. Sometime in October, one of the isolated specimens laid about 10-15 small white infertile eggs. No note was kept of this event, regretfully.

Any fact-finding regarding self-fertilization was precluded when the 5 specimens were allowed to die during aestivation (May 6, 1957 and beyond).

No. 4 compared with No.'s 1 and 8. Specimen #1 (solid line) began as a 6 mm. infant and ended as a 116 mm. adult. It was quickly overtaken by #4 at end of infancy. Thence, #1 lagged behind #4 until it (#1) overtook #4 at 77 mm. and passed #4 at end of adolescence at 94 mm. Soon after end of adolescence, #1 was overtaken by #4 and thereafter leveled off quickly while #4 continued climbing steadily but at a decelerated rate.

No. 1 had 3 periods of aestivation (black bars): the first lasting 8 days, the second 42 days, the third 47 days and beyond until death without emergence from aestivation sometime after May 6.

No. 8 began as a 5 mm. infant and completed its maturity at 110 mm. Its infant and adolescent growth rate (not plotted) clung closely to those of #1 and #4 until end of adolescence (see table). Thence, the rate (plotted) diverged and stayed below those of #1 and #4.

Onset of #8's aestivation coincided with that of #4. No. 8 was allowed to die in aestivation. A sample of #8's loss of weight is plotted in the top graph. Its weight was taken just before it went into aestivation at 142.8 grams. At the end of 83 days, it weighed 129.3 grams, a loss of 13.6 grams which averaged out to 0.16 grams per day loss. This average loss of body weight in aestivation is confirmed by the loss of weight in four other specimens, namely, A, B, C, and #9, the data of which will be presented at a later date.

The growth rates of #9 and 10 (unplotted) show similar patterns with individual variations after the end of adolescence. I believe the patterns of growth described for #1, 4, and 8 under

infancy, adolescence, young adult, and maturity, represent a characteristic mode for *Achatina fulica*.

Diameter. The chart of the diameters of #1 and 4 (middle graph) is an instructive one. There is a definite correlation between linear and diametric growth in relation to their four stages of growth, namely, infancy, adolescence, young adult, and maturity.

No. 1 demonstrates a fairly smooth curve, thereby proving itself to be a normal average *A. fulica* having a symmetrical helix as its shell. On the other hand, #4 appears to be slightly out of rhythm, fluctuating somewhat erratically and unpredictably, first broadening beyond #1 just as their lengths coincide (June 25), next narrowing (August 27) when its own length is surpassing that of #1. The result is that the shell of #4 has a less symmetrical and a slimmer outline than that of symmetrical #1.

Whorls. The top graph shows that the accretion of whorls is accomplished in an orderly and regularly manner, the first 8 whorls being attained quickly (4 months) in concert with length and diameter. Thence, the accretion levels off with only a small rise from 8.3 to 8.5 at November 2 (#1). The data for snail #4 (not plotted) differs only slightly in that there is a 0.2 of a whorl more at May 1956.

Lateral growth, No. 10. Lateral growth of the lip was sampled but not continued to the end. In a 14-day period, near the end of adolescence (July 2 to 16) the lip of #10 grew 55 mm. or 3.9 mm. per day. At the same time the length of the shell grew increased 18 mm. (extrapolated from #1). In the next lateral measurement, the lip grew 17 mm. in 28 days or 0.6 mm. per day (September 17 to October 15). During this lateral growth, #10 grew only 2 mm. longitudinally.

Each point of the growing lip grows at a rate that is different from that of any other point on the same lip. In #10 a point 10 mm. below the suture was selected arbitrarily for mensuration.

Aestivation. Aestivation or snail hibernation is a conspicuous function in *Achatina fulica*. The snail becomes lethargic, withdraws into the shell, secretes an epiphragm (or hibernaculum) which seals the animal from the external environment, and remains in a state of torpor for days, weeks, and months.

Aestivation apparently is brought on by two main factors,

namely, a seasonal physiological change and by factors adverse to the economy of the snail's living process. Ghose gives November to June as a seasonal period of aestivation. The February to May (#4, 8) and March to May (#1) aestivation periods tend to support his findings. Ghose found that the reproductive organs prepare for egg-laying during aestivation.

Among the factors causing aestivation are dryness and heat of summer, starvation, low temperature and low humidity. This is a subject needing closer study.

The epiphragm seals the aperture of the shell almost completely, leaving a minute slit at the middle of the seal for respiration. When the snail is ready to aestivate, it withdraws into the shell and secretes a kind of mucus that hardens quickly. The epiphragm is paper-thin, white, and brittle. If disturbed, the snail might push the epiphragm out, protrude slightly, then withdraw and form another epiphragm. If protrusion is a natural one, it might feed on the fragments of the epiphragm, indicating that there is a certain amount of lime in this.

Upon emerging from aestivation, the snail remains lethargic for hours and often will not feed immediately indicating that long aestivation may not be correlated with hunger in every instance.

REFERENCES

- Ghose, K. C., 1959. Observations on the mating and oviposition of two land pulmonates, *Achatina fulica* Bowdich and *Macrochlamys indica* Godwin-Austen. J. Bombay Nat. Hist. Soc. 56 (2):183-187.
- 1960. Observations on the gametes, fertilization and gonadal activities of two land pulmonata *Achatina fulica* Bowdich and *Macrochlamys indica* Godwin-Austen. Proc. Zool. Soc., (Calcutta) 13 (2):91-96.
- Lange, W. Harry, Jr., 1950. Life history and feeding habits of the giant African snail on Saipan. Pacific Science 4 (4):323-335.
- Mead, A. L., 1950. The problem of the giant African snail (*Achatina fulica*) in Micronesia. Pacific Science Board, National Research Council, Mimeograph Report.
- 1961. The giant African snail: A problem in economic malacology. University of Chicago Press.
- Mohr, J. C. Van Der Meer, 1949. On the reproductive capacity of the African or giant snail *Achatina fulica* (Fer.). Treubia 20 (1):1-10.
- Rees, W. J. 1950. The giant African snail. Proc. Zool. Soc. London 120 (3):577-598.

HELIX ASPERSA IN LOUISIANA*

BY PATTI WATT HERMANN AND DEE SAUNDERS DUNDEE

Louisiana State Universities in Baton Rouge and in New Orleans

Helix aspersa Müller has been recorded from three localities in Louisiana: Baton Rouge (Featherman, 1871; Binney, 1885; Harry, 1948); New Orleans (Tryon, 1866; Viosca, 1928); and Shreveport (Branson, 1961). The latter record consisted of 3 adults from a plant nursery.

In 1948 Harry collected in New Orleans and did not find this species; the present authors have done extensive collecting there also without finding it. Therefore, it seems likely that *H. aspersa* is no longer present in New Orleans having last been reported there in 1928 by Viosca.

Baton Rouge, however, still has a colony of *H. aspersa*. On September 28, 1963, 11 live specimens were found in the back yard of a residence at 202 East Boulevard. From this same area, Harry (1948) reported collecting this snail 15 years ago.

This residence is reported to be at least 50 years old and possibly 100. The ground under the house is barren of vegetation and offers little cover for snails. *Helix aspersa* was found under a pile of lumber which was lying adjacent to a small shed. The board had been there only two months, having been transported from a demolished garage at 165 East Boulevard (a brief check along that lot revealed no *Helix*). Most of the snails were found between the lowest boards and the leaf littered ground or near the bottom of the pile thus being in the dampest area.

Two of the 11 specimens were accidentally crushed, 5 were collected and 4 were left under the lumber pile. One was in the process of laying eggs and was still doing so 3 hours later in the collecting container.

Other gastropods found under the boards were 19 *Limax flavus* and a few *Zonitoides arboreus*. Two clutches of *Limax* eggs were seen. *Lamellaxis gracilis* and *Hawaiiia minuscula* were found in other parts of the yard.

In subsequent trips to this area, shells were found 4 blocks to the south and one block to the west of this address. No other localities with living *Helix* have been found, however.

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The rediscovery of *Helix aspersa* in Baton Rouge 15 years after it was last reported and nearly 100 years after it was first reported once again points up the tenacity of some introduced species of organisms. Once introduced, they survive despite the fact that, in a case such as this, a large city grows around them. And, like many introduced forms, they become pests such as are these.

LITERATURE CITED

- Binney, W. G. 1885. A manual of American land shells. Bull. U.S. Nat'l. Mus. 28.
- Branson, B. A. 1961. Notes on some gastropods from northern Louisiana. Proc. La. Acad. Sci. 24: 24-30.
- Dundee, D. S. and Watt, P. A. 1961. Louisiana land snails with new records. Naut. 75 (2): 29-82.
- Featherman, A. 1871. Report of a botanical survey of southern and central Louisiana, made during the years 1869-1871. Ann. Rept. Board of Supervisors, La. State Univ.: 131.
- Harry, H. W. 1948. Notes on foreign land snails of Louisiana. Naut. 62 (1): 20-24.
- Tryon, G. W., Jr. 1866. Monograph of the terrestrial Mollusca of the United States. Amer. Jour. Conch. 2: 218-277.
- Viosca, P. 1928. European land snails in New Orleans. Naut. 41 (4): 139-40.
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THE PRESENT NOT ALWAYS KEY TO THE PAST

By DAVID NICOL

Dept. of Geology, Southern Illinois University, Carbondale

Recently in the Nautilus (1964, 77: 92-93) the writer pointed out that shell-attached marine pelecypods like the chamids are not found in the arctic and antartic regions today and are also rare in cold deep water elsewhere. About 20 years ago and also in Nautilus (1944, 57: 90-93), the writer presented the fact that shell-attached marine pelecypods were not present in Ordovician, Silurian, Devonian, and Mississippian strata and are certainly very rare in Pennsylvania and Permian strata. Does this mean that the Paleozoic seas were cold? Certainly not. It only means that the pelecypods commonly adopted this mode of attachment after the Paleozoic. Only after the Paleozoic did the pelecypods begin to show their great diversity and greatest amount of adaptive radiation.

Equally mistaken conclusions might be made by comparing

living species of other major groups with their Paleozoic congeners. Some historical geology textbooks assert that the climate during Pennsylvanian time probably was very warm because many of the insects attained a size unsurpassed by any living insect; i.e., all living insects of unusually large size live in tropical areas, and therefore the large Pennsylvania insects must have lived in a very warm climate. However, not all groups of animals follow Cope's Rule, and perhaps some of the more primitive insects were the largest as merely a stage in their evolutionary development.

One more example of a possible erroneous conclusion can be based on the maximum shell size of a mollusk group. The nautiloids apparently attained their largest size in the Ordovician seas. The largest calcareous-shelled species in many groups of invertebrates are found in warm seas today (e.g., the largest pelecypods, the large Foraminifera). Does this mean that Ordovician seas were warmer than those of the Silurian and all later geologic periods because the nautiloids attained their maximum adult size in the Ordovician?

The obvious lesson here is to be careful in drawing paleoecologic conclusions, particularly when one is dealing with Paleozoic organisms that are often not closely related to modern ones.

LITERATURE CITED

- Nicol, David, 1944. Observations on *Pseudomonotis*, a Late Paleozoic pelecypod: *Nautilus* 57 (3): 90-93.
——, 1964. Lack of shell-attached pelecypods in Arctic and Antarctic waters: *Nautilus* 77 (3): 92-93.

NOTES ON A HYBRID TELLINA (TELLINIDAE)

By KENNETH J. BOSS

U.S. Fish and Wildlife Service, Washington, D.C.

The occurrence of hybridization between species or genera of mollusks has been reported infrequently in the literature. A general review of possible cases has been given by Pelseneer (1920). Data on natural and experimental hybridization between species of the land snail *Cerion* (Bartsch, 1920 and 1955; Mayr and Rosen, 1956) suggest that the phenomenon may occur with some frequency. In the Bivalvia, experimental hybridization has been studied and obtained between species of *Ostrea*

and *Crassostrea* (Seno and Hori [in] Miyazaki, 1939; Davis, 1950), *Pholas* [*Zirfaea* + *Barnea*] (Pelseneer, 1920), *Venus* [*Mercenaria*] (Chestnut, Fahy, and Porter, 1957) and *Pinctada* (Matsui, 1958). In many cases the experimental hybrids are subject to high, if not complete, mortality. Some evidence has been marshalled to show that certain species or subspecies of North American unionids hybridize (Clarke and Berg, 1959). The example given herein records a case of hybridization between two closely related species of the genus *Tellina*.

The hybrid specimen and the specimens of the parental species (Plate 3, figs. 1, 2, 3) were collected in Bermuda by Mr. Russell H. Jensen of Bloomfield, New Jersey, in September 1963. He kindly sent them to the author for study. The two species involved, *Tellina magna* Spengler, 1789 and *T. laevigata* Linnaeus, 1758, are largely sympatric and closely related but possess a number of qualitative as well as quantitative species characteristics. The populations sampled by Mr. Jensen came from Tucker's Bay, Harrington Sound. The average depth of water was 6 feet and the individuals were living 12 inches below the surface of a fine sand substrate. The sample consisted of 2 specimens of *magna*, 7 of *laevigata* and the unique hybrid.

Conchologically, *magna* may be separated from *laevigata* by its elongate-elliptical shape, its lateral compression, its generally whitish coloration, which may be suffused centrally with pink, orange, and red, and by its obsolete posterior lateral tooth in the right valve. In addition, the ligament of *magna* is somewhat sunken and the margins of the valve in this area are sharp; whereas in *laevigata* the ligament is more protuberant and its margins are smooth and beveled. The periphery of the shell in *laevigata* is typically orange-yellow. The convexities of the valves and the outlines of the shells may be quantified by measurements of lengths, widths, heights, and ratios thereof.

Based on measurements of series of each species, including the samples from Bermuda, the mean length-height ratio for *magna* is 1.8 with a range from 1.6 to 2.1, for *laevigata* 1.3 with a range from 1.2 to 1.4; the mean length-width ratio for *magna* is 5.7 with a range from 5.4 to 6.3, for *laevigata* 3.5 with a range from 2.9 to 3.8. These ratios show that *magna* is proportionally more elongate and more compressed than *laevigata*.

The hybrid specimen is intermediate in its qualitative concho-

logical characteristics. It has an internal suffusion of colors which is unlike that of *magna* but like that of *laevigata* in as much as the suffusion is not concentrated centrally, but peripherally. On the other hand, the umbo shows the typical external concentration of orange-red coloration which is generally found in specimens of *magna*. The right posterior lateral tooth is weakly developed but is more definitive than the obsolete tooth in *magna* and less definitive than the strong tooth possessed by *laevigata*. Since the characteristics of the dispensation of coloration alone seem to be unsatisfactory criteria upon which to conclude that a specimen is a hybrid, the shape of the shell was also considered.

The measurements of the hybrid are: length 78.7 mm.; height 51.3 mm.; width 20.5 mm. The length-height ratio is 1.53 and the length-width ratio is 3.8. The former lies clearly out of the range of these ratios for either parental species and the latter coincides with the greatest extreme of *laevigata*. In any case, the ratios of the hybrid are well separated from the means of the parental species and the shape of the shell is intermediate in its dimensions.

Consideration of the occurrence of a hybrid between *laevigata* and *magna* lends credence to their inclusion in the subgenus *Laciolina* Iredale, a procedure followed in the author's forthcoming monograph of the Tellininae. It also calls attention to some inherent weaknesses in the establishment of subgenera in the Tellinidae on lateral dentition alone. As practiced in other taxonomic groups, the hybrid may be referred to as *Tellina magna* x *laevigata*.

The discovery of an adult hybrid between two closely related and relatively abundant western Atlantic tellens not only adds another record of hybridization among bivalves, but opens a promising avenue for experimental research. The stability of *magna* and *laevigata* indicates that the hybrid is probably infertile for there has not been any introgressive merging of populations of the parental species.

The author wishes to acknowledge the suggestions given by Drs. J. Rosewater and W. J. Clench, who critically read the manuscript.

LITERATURE CITED

- Bartsch, P. 1920. Experiments in the breeding of cerions. Dept. Marine Biol., Carnegie Inst., Washington 14 (282):55, 59 pls.

- Bartsch, P. 1955. The pyramidellid mollusks of the Pliocene deposits of North St. Petersburg, Florida. *Smithson. Misc. Coll.* 125 (2):102, 18 pls.
- Chestnut, A. F., Fahy, W. E., and H. J. Porter. 1957. Growth of young *Venus mercenaria*, *V. campechiensis* and their hybrids. *Proc. Nat. Shellfish Assn.*, 47:50-56, fig. 1, tabs. 1-2.
- Clarke, A. H. Jr., and C. O. Berg. 1959. The freshwater mussels of central New York. Agricultural Experiment Station, Cornell University, Mem. 367, 79 pp., 8 pls.
- Davis, H. C. 1950. On interspecific hybridization in *Ostrea*. *Science* 3 (2889):5221.
- Matsui, Y. 1958. Aspects of the environment of pearl-culture grounds and the problems of hybridization in the genus *Pinctada*. [in] Buzzati-Traverso. *Perspectives in Marine Biology*, pp. 519-531. University of California Press. Berkeley and Los Angeles.
- Mayr, E., and C. B. Rosen. 1956. Geographic variation and hybridizations in populations of Bahama snails (*Cerion*). *Amer. Mus. Novitates*, no. 1806, 48 pp.
- Miyazaki, I. 1939. Some notes on the cross-fertilization of Japanese oysters. *Bull. Jap. Soc. Sci. Fish.*, Tokyo, 7:257-261.
- Pelseneer, P. 1920. Les variations et leur hérédité chez les mollusques. Hayez, Bruxelles, 826 pp.

INVESTIGATIONS ON BIOLOGICAL CONTROL OF GIANT AFRICAN (ACHATINA FULICA) AND OTHER LAND SNAILS

BY N. L. H. KRAUSS

State Department of Agriculture, Honolulu, Hawaii

This paper briefly records investigations on various predators of land snails carried on by the author during several periods from 1950 to date. Only the species sent to Hawaii for release or study in quarantine are listed. The main purpose of the work was to establish in Hawaii predators which would reduce the enormous numbers of the giant African snail, *Achatina fulica* Bowdich, which was introduced into the islands from Taiwan and Japan in 1936. I also hoped that some of the predators would exert control on various small garden snail pests. Five species of the predators are known to have become established: the snails *Gonaxis kibweziensis* (E. A. Smith), *G. quadrilateralis* (Preston), *Gulella wahlbergi* (Krauss) and *Euglandina rosea* (Férussac), and the carabid beetle *Tefflus zanzibaricus alluaudi* Sternberg.

Among the persons who aided me in these investigations, I

would like to mention especially Joseph C. Bequaert, Harvard University; Yoshio Kondo, B. P. Bishop Museum, Honolulu; Francis X. Williams, San Diego, California; Martin H. Muma, Citrus Experiment Station, Lake Alfred, Florida; C. F. McLaughlan, Sydney, Australia; J. Hope MacPherson, National Museum of Victoria, Melbourne; Bernard Verdcourt, East African Herbarium, Nairobi; Maxwell Trench, Diani Beach, Kenya; Keizo Yasumatsu, Kyushu University, Fukuoka, Japan; Nobukiyo Takahashi, Tokyo University Forest, Yamabe, Hokkaido, Japan; Henry Fernando, Department of Agriculture, Peradeniya, Ceylon; and Hugo de Souza Lopes, Instituto Oswaldo Cruz, Rio de Janeiro.

The predacious snails and beetles sent to Hawaii were handled, propagated, studied, and, in some cases, released by Q. C. Chock, C. J. Davis, Harry Nakao, Mabel Chong and other members of the staff of the Entomology Branch, State Department of Agriculture (formerly Board of Agriculture and Forestry), and Yoshio Kondo, B. P. Bishop Museum.

PREDACIOUS SNAILS: Streptaxidae

Gonaxis kibweziensis (E. A. Smith). In 1947-48 Francis X. Williams investigated this snail in Kenya (Williams, 1951). Some were sent to Hawaii for study but they were not released. In the period June-December 1951, the writer sent several shipments to Honolulu from Diani Beach, Kenya. The first release was made in June 1952 at Kaneohe, Oahu. In 1950, R. Tucker Abbott sent many of the snails from Diani Beach to Agiguan Island in the Mariana group, western Pacific and they were released there. C. J. Davis in 1954 brought several hundred of the snails from Agiguan to Hawaii and they were released at Kaneohe in August. This species is now well established on Oahu and Maui. A few *Gonaxis* sp. from Amani, Tanganyika were sent to Honolulu in November and December 1951 but these were not released.

Gonaxis quadrilateralis (Preston). In June 1957, I found large numbers of immature and adult snails of this species among seedling mvule trees in a nursery of the Forest Department and surrounding forest at Kwale, Kenya (elevation about 1,200 feet). Several shipments, totaling 5,476 snails, were sent to Honolulu, and liberations were made on Oahu and Maui beginning in June. The snails are established on both islands and are considered the most important of the predators on *Achatina* (Davis and Butler, 1964). The shells of the Kwale individuals were rather

fragile and the orange bodies could be seen through them. *Achatina* of various sizes were numerous in the area.

Gonaxis vulcani Thiele. This species was sent to Honolulu from Yangambi, on the Congo River, Republic of the Congo (formerly Belgian Congo) in October-November, 1956. It was released at Waiahole, Oahu during the same months.

Gulella wahlbergii (Krauss). Large numbers of these snails were collected among fallen leaves and humus under a dense growth of trees and shrubs on the Bluff, Durban, South Africa in December 1956-February 1957. They were released on Oahu and at Haiku, Maui in 1956-57. Recoveries were made in Nuuanu Valley, Oahu on September 8, 1960, and February 18, 1964.

Gulella bicolor (Hutton). This small species was sent to Honolulu from Manila, Philippines in October, 1957; from Susupe, Saipan, Mariana Is. in February, 1958; and in very large numbers from Kuala Lumpur, Malaya in August-September 1958. At Manila it was observed feeding on *Subulina octona* Bruguiere. Some were released on Oahu in October-November, 1957, and March and August, 1958, but the largest number (600) were liberated at Hilo, Hawaii in September 1958. Dr. Kondo has advised me that he found one dead specimen of this species on the University of Hawaii campus, Honolulu, in 1940 or 1941.

Gulella sp.; about 15 mm. long, yellow bodies, orange antennae. Fifty-eight of these, collected at Port Shepstone, Natal, South Africa, were forwarded to Hawaii.

Gulella sp. This species was collected among dead leaves on the ground at Yangambi, Republic of the Congo, in October, 1956. It was released at Kaneohe, Oahu in November.

Gulella sp. probably *G. planti* (Pfeiffer). Some of these were found on the Bluff, Durban, South Africa in November 1956-February 1957 and sent to Honolulu.

Edentulina affinis C. R. Boettger. Several of these snails were collected at Diani Beach, Kenya in August and September 1951 and in May 1957, and these were sent to Honolulu. One individual was released in the Kaneohe district, Oahu in June 1957. The body of this species is orange. A few *Edentulina* sp. were collected in the forest at Amani, Tanganyika in October-November 1951.

Edentulina obesa var. *bulimiformis* (Grandidier). A few individuals were collected at Diani Beach in June 1957. Four were

released at Tantalus, Oahu in August. The pearly shell is about an inch long, and the body bright green.

Ptychotrema walikalense Pilsbry. Collected among dead leaves on the ground in the forest at Yangambi, Republic of the Congo in October 1956. Released in Kaneohe, Oahu in November.

Ptychotrema sp. Forwarded to Honolulu from Yangambi, Republic of the Congo in October 1956; not released.

Streptaxis contusus (Férussac). The pearly shells are about 22 mm. in diameter and the bodies are yellowish-orange in color. A number of individuals were obtained at Rio de Janeiro in April 1961 through the cooperation of Hugo de Souza Lopes of the Instituto Oswaldo Cruz. Eighteen were released at Kapaa Homesteads, Kauai on May 24.

Spiraxidae

Euglandina rosea (Férussac). During September-November 1955 large numbers of this predacious snail were collected near Whitney, at Gainesville, Silver Glen Springs, Lakeland and near Astor, Florida and sent to Honolulu. Nearly all these were from orange groves near Whitney in Sumter County (near the city of Leesburg). The snails were on the ground or a foot or two up the trunks of the trees, sheltering under empty fertilizer bags in the crotches of the trees. They were feeding on the citrus tree snails, *Drymaeus* sp. In June and July, 1956, more snails and eggs collected in the Whitney area were forwarded. Alan Thistle of the Hawaii State Department of Agriculture sent further shipments in 1957. The first releases were made on Oahu in November 1955. The snail was found established in 1957, and is now established on the islands of Oahu, Maui, Hawaii and Kauai. It is fond of the garden snail *Bradybaena similaris* (Férussac) as well as *Achatina*.

Euglandina singleyana (W. G. Binney). One live individual about 1½ in. long was found on a wall at Goliad, Goliad Co., Texas in August 1963. It was sent to Honolulu and readily fed on *Achatina fulica* in the laboratory.

Salasiella (Laevoleacina) oleacea straminea (Deshayes). The shells are a glossy amber color, and the bodies yellowish-brown. These were collected in good numbers in Vinales Valley, Cuba in November-December, 1955, and June, 1956. They were released at Kualoa, Oahu in January and July, 1956. A further lot collected by Alan Thistle in Vinales Valley in 1957 was released

at Hakipuu, Oahu in May of that year.

Salasiella sp.? This species was collected at Camoa and Caimito, Cuba in November-December, 1955, and June, 1956. It was released at Kualoa, Oahu in July, 1956.

Oleacinidae

Varicella sp. Several individuals were collected at Cobre River Gorge, Jamaica, in December, 1955, and forwarded to Honolulu.

Rhytididae

Natalina caffra (Férussac). A number of these large snails were collected on the Bluff at Durban, Port Shepstone and Scottburgh in Natal, South Africa in December 1956-February 1957 and sent to Honolulu. In June, 1958, some more were received from G. R. McLachlan, Museum and Snake Park, Port Elizabeth, South Africa. These were studied in quarantine but not released.

Rhytida spp. Nine *Rhytida inaequalis* Pfeiffer, collected at Sarramea, near La Foa, New Caledonia in July, 1950, and several *R. ferreziana* Crosse found at Montagne des Sources, N. C. in August were forwarded to Honolulu. They were found under logs, etc. in the forest.

Paryphanta compacta Cox & Hedley. Forty-five of these snails were collected under logs, etc. in a forested area near Forrest, Victoria, Australia in April 1950 and sent to Honolulu. They did not survive long in the laboratory. The shells are about an inch in diameter and a glossy blackish in color.

Strangesta capillacea (Férussac). Eight young individuals collected at Sydney, Australia were sent to Honolulu in April 1950 but died in quarantine.

Zonitidae

Oxychilus cellarius (Müller). 206 of these small predacious snails from Sydney, Australia were shipped to Honolulu in April 1950 but all died in quarantine within several months, probably due to the heat.

Haplotrematidae

Haplotrema vancouverense (Lea). A few of these predacious snails found under logs, boards, etc. at Corvallis, Oregon in May, 1963, were sent to Honolulu. Several more of probably the same species from Charleston and Brookings, Oregon were forwarded in June.

PREDACIOUS BEETLES: Carabidae

Tefflus zanzibaricus alluaudi Sternberg. Good numbers of this

large black beetle, about 45-50 mm. long, were collected among fallen leaves, etc. in the forest at Diani Beach, Kenya in June-September 1951 and April-June 1957. The first releases were made on Oahu in June 1952. In July 1959 some additional ones were received from D. J. McCrae in Kenya. The beetles are established in the islands, recoveries having been made in 1958 and 1960.

Tefflus purpureipennis wituensis Kolbe. This species is smaller than the preceding, being about 35 mm. long. Large numbers were collected at Diani Beach in September 1951 and April-June 1957 and sent to Hawaii. Additional adults were sent from Kenya by D. J. McCrae in 1959. All releases were made on Oahu, beginning in May 1957.

Tefflus jamesoni Bates and *T. tenuicollis* (Fairmaire). These predacious beetles were collected in the forest at Yangambi and Bengamisa, Republic of the Congo in October-November, 1956, and were released in the Kaneohe area of Oahu in the same months. Neither species is known to be established.

Thermophilum hexastictum Gerstaecker. Several of these beetles, which may feed on snails as well as caterpillars, were collected at Diani Beach, Kenya in April 1957, and three were released in Kaneohe, Oahu in May.

Damaster blaptoides blaptoides Kollar. Adults and larvae of this large predacious beetle were collected under fallen leaves, piles of cut grass, debris, etc. and in traps baited with crushed snails at Fukuoka, Kyushu, Japan in June-July, 1958. These were released on Oahu and Maui in July. In 1959 and 1961 additional beetles sent from Fukuoka by Prof. Keizo Yasumatsu were released on Oahu, Maui and Kauai.

Damaster blaptoides rugipennis Motschulsky. These carabids were collected in tins set as mouse traps in the bottoms of small ditches surrounding plantings of forest tree seedlings at Yamabe, Hokkaido, Japan in July, 1958. Forty-six were released on Mt. Tantalus, Oahu on July 28.

Scaphinotus sp. Several adults of this snail-eating beetle found under boards and logs at Corvallis, Oregon in May 1963 were forwarded to Honolulu.

Drilidae

Undetermined species. Two bristly brown larvae about an inch long found crawling on walls at Rabat, Morocco in April 1962 were sent to Hawaii.

Lampyridae

Lamprophorus tenebrosus (Walker). The larvae of this giant firefly were sent to Honolulu in large numbers from the Kandy area of Ceylon by Henry Fernando and Henry A. Bess in 1954 and 1956. In August, 1957, the writer shipped 8,665 larvae of various sizes collected under leaves and debris in cacao plantations of the Pallekelle group of estates, 6 to 8 miles from Kandy, to Honolulu, and in October 1958 another 3,026 larvae were sent from the same area. The larvae were released on Oahu during the period 1954-58 and on Maui in 1958, but no recoveries have been made.

Colophotia concolor E. Olivier and *Pyrophanes quadrimaculata* var. *bimaculata* E. Olivier. Four lots totalling 460 adults of these lampyrids collected at Pasonanea Park, Zamboanga, Mindanao, Philippines were sent to Honolulu in December, 1958. They were not released.

REFERENCES

- Davis, C. J. and G. D. Butler, Jr. 1964. Introduced enemies of the giant African snail, *Achatina fulica* Bowdich, in Hawaii (Pulmonata: Achatinidae). Proc. Hawaiian Ent. Soc. Vol. 18, in press.
- Krauss, N. L. H. 1951-1963. Monthly reports on biological control investigations. Hawaii Bd. Agr. and For. and Hawaii Dept. Agr. (Dittographed and mimeographed).
- Mead, Albert R. 1961. The giant African snail: a problem in economic malacology. Chicago, University of Chicago Press, 257 pp.
- Williams, F. X. 1951. Life-history studies of East African *Achatina* snails. Bull. Mus. Comp. Zoo., Harvard Coll., 105 (3): 295-317.

NOTES AND NEWS

DATES OF NAUTILUS.—Vol. 77, No. 1, pp. 1 to 36, pls. 1 to 4, was mailed July 6, 1963. No. 2, pp. 37 to 72, Oct. 5, 1963. No. 3, pp. 75 to 108, iii, January 7, 1964. No. 4, pp. 108 to 144, pls. 5 to 9, April 14, 1964.—H. B. B.

STROBILOPS AENEA WEST OF THE MISSISSIPPI RIVER.—The statement has been made that *Strobilops aenea* Pilsbry does not occur west of the Mississippi River (Branson, B. A. 1961. Proc. Okla. Acad. Sci. vol. 41. p. 62.). However, I have a number of collections from there. From Iowa I have collected it in Fayette, Clayton, Jackson, and Muscatine Counties. In Missouri it is known from St. Louis, Franklin, Jefferson, and Washington Counties.

In Arkansas I have found it in Columbia and Union Counties. I have also found it in Caddo Parish, Louisiana, and Tyler County, Texas.

I have also collected it in river drift on the South Canadian River, north of Whitefield, Haskell County, Oklahoma, and on the Red River, at Fulton, Hempstead County, Arkansas. But as there are no fresh shells in either of these lots they may have been washed from Pleistocene deposits.—LESLIE HUBRICHT.

HELICODISCUS TRIDENS AND H. ALDRICHIANA.—Recently I examined specimens of *Pilsbryna tridens* Morrison and *Clappiella aldrichiana* (Clapp) and believe that both species should be placed in the genus *Helicodiscus*.

A large series of specimens of *Helicodiscus tridens* was collected in drift of the South Canadian River, north of Whitefield, Haskell Co., Oklahoma. Most of the specimens appeared to have been washed from Pleistocene deposits, but some were quite fresh so that this species must be living today in Oklahoma.

Thirteen specimens of *Helicodiscus aldrichiana* were collected in fine rubble on a chert hillside, 0.5 mile north of Hammondville, DeKalb Co., Alabama. One specimen was dissected, but unfortunately it was not sexually mature. The animal is yellow with an orange margin to the mantle, a color pattern found in several species of *Helicodiscus*.—LESLIE HUBRICHT.

ASIATIC CLAM INFESTATION AT CHARLESTON, WEST VIRGINIA.—The Asiatic clam, *Corbicula fluminea* (Müller), has extended its range into the Kanawha River. The clam was collected from the Kanawha July 17, 1963, at Chelyan, West Virginia. The population was limited to a few live clams in the center of the river, but large numbers of open shells were collected from the banks of the river.

During the same period, an inquiry, later followed by samples of clam shells, was received from Union Carbide Olefins Company, 15 miles upstream from Charleston, West Virginia. The plant obtains raw water from the Kanawha River. The water passes through a traveling screen to a sump. Centrifugal pumps then pump the water to an elevated storage tank from which it flows by gravity to heat exchangers and thence to the river.

As the result of the infestation during the summer of 1963, clam shells lodged in valves on some of the water lines and re-

stricted the flow of water. Clams were also noted when heat exchangers were flushed. Since the traveling screen would prevent passage of adult clams, assumably the sump and elevated storage tank were the nursery areas for the clams found in the water lines and heat exchanger. Partial control was accomplished by increasing the flow velocities in the water lines, thus removing the sediment that formed a substrate for the clams.

Individual clam sizes up to 27 mm. indicate that a population has been established in the Kanawha River since 1961. This is based on size "year class" data presented by Keup et al. 1963, Keup, L., W. B. Horning and W. M. Ingram. *Nautilus* 77 (1):18-21.—N. A. THOMAS and K. M. MACKENTHUN, Biologists; Technical Advisory and Investigations Section, R. A. Taft Sanitary Engineering Center, U. S. Department of Health Education and Welfare, Public Health Service, Cincinnati, Ohio.

DECLINE OF ASIATIC CLAM IN OHIO RIVER.—Benthic samples taken from the Ohio River near Cincinnati, Ohio, during 1962 contained large numbers of the Asiatic clam, *Corbicula fluminea* (Müller) [Stein, E. B., *Ohio Journ. Sci.*, 62 (6):326-327, 1962; and Keup, L., Horning, W. B., and Ingram, W. M., *Naut.* 77 (1):18-21, 1963]. Quantitative bottom samples collected from Cincinnati downstream to Warsaw, Kentucky, showed the Asiatic clam to be the dominant benthic organism in September, 1962 (Keup, et al., op. cit.).

Quantitative benthic samples were collected in September and October, 1963, at the same stations that were sampled in 1962. Comparison of the two years' data indicates a near elimination of the Asiatic clam from the Cincinnati reach of the Ohio River during the interval of a year. At River Mile 461.5, live Asiatic clams were reduced from 27 to 1 per square foot of bottom. Four other stations sampled had live Asiatic clam populations ranging from 20 to 222 per square foot in 1962; in 1963 no live Asiatic clams were found at these 4 stations.

Explanations for the sudden decline of the Asiatic clam population remain open for speculation. A possible explanation lies in the severity of the 1962-63 winter. This winter had the coldest (-14°F) recorded air temperature since 1936 (-17°F); and the Ohio River was frozen over the longest (7 days) since the winter of 1947-48 (12 days) (unpublished: U. S. Weather Bureau Data). The clam originates from more temperate cli-

mates in southeast Asia and the abnormally severe Ohio valley winter conditions may have caused a "winter kill" in the clam population.—W. B. HORNING and LOWELL KEUP, Biologists; Technical Advisory and Investigations Section, R. A. Taft Sanitary Engineering Center, U. S. Department of Health, Education, and Welfare, Public Health Service, Cincinnati, Ohio.

STREAM DISPERSAL OF MESODON—On March 15, 1942, on the West Fork of White River, Marion County, Decatur Township near intersection with W. Thompson Road, Indiana, a water-soaked specimen of *Mesodon clausus* (Say) was found floating in the river with the animal inertly extended. Upon being harshly stimulated, the snail retracted itself into its shell. Therefore, probably if stranded by receding water, this specimen might have survived at a new spot in so far as effect of immersion might be involved. At another place, an adult *Mesodon thyroideus* (Say) was also found floating in a flooded lowland near the main channel of the river. The animal also was water-soaked and extended. Unfortunately this specimen was lost, so my plan to study its survival aborted.—Dr. GLENN R. WEBB, Kutztown State College, Kutztown, Pa.

COURTSHIP BETWEEN TWO SPECIES OF HELMINTHOGLYPTA—On November 26, 1941, an animal of *Helminthoglypta tudiculata* (Binney) was found head-on to one of *H. umbilicata* (Pilsbry). A black, tubular body (penis?) was seen to extend from the *tudiculata* and to be pressed against the dilated genital-pore region of the *umbilicata*. Action ceased after I inverted the cage cover-glass. But again on November 29th, this pair was found in an oblique head-on position. Both snails had the genitalia partly protruded. The organs of the *tudiculata* were very dark, almost black and much darker in color than the pale organs of the *umbilicata*. The dart-organ of the *tudiculata* was very small, but perhaps it was not fully everted. After the foregoing was seen, I went to get pen and notebook. When I returned, the *tudiculata* had fallen from the cover-glass and was lying with its foot in the air on its spire. Possibly the *umbilicata* had stabbed the *tudiculata* so vigorously that the latter fell in pain from the cover-glass. The fallen *tudiculata* eventually climbed back up and rejoined the *umbilicata* on the cover-glass. Then the *umbilicata* harassed the *tudiculata* by a biting attack which caused

the *tudiculata* to arch itself violently away and to withdraw from proximity. The pair again became briefly separated. When the specimens again met, the *umbilicata* employed its dart from the tip of the dart-organ against the sole of the foot of the *tudiculata*. The *tudiculata* jerked violently and again withdrew. The *tudiculata* made no attempt to reciprocate with its own dart-organ. The present two instances suggest that a possible sex-organ and mating-behavior barrier exists between these two species to preclude any interbreeding. This is a field worthy of exploration by observant collectors and malacologists.—GLENN R. WEBB.

FREEZING VERSUS POLYGYRA SEPTEMVOLVA SAY—On October 31, 1941, 3 specimens of this species were tested to obtain pilot data in regard to whether freezing weather might be an important factor in restricting the species in distribution to the Gulf and south Atlantic coastal areas. The results were as follows: Three aestivating specimens survived nearly 24 hours of 36°F. in the refrigerator; only one out of three aestivating specimens survived nearly 24 hours of slightly below 32°F. in the refrigerator. The surviving specimen seemed normal and continued to survive when returned to its cage. The specimens in question were collected at Port St. Joe, Florida. I am indebted to James T. Close of Indianapolis, Indiana, for helping secure the material.—GLENN R. WEBB.

TWO EASTERN LAND SNAILS NEW TO TEXAS.—This note reports on specimens of one species and one subspecies of snails not previously reported from Texas. I wish to express my gratitude to the membership of the J. K. Strecker Herpetological Society for saving the snails they often find while searching for reptiles and amphibians.

Haplotrema concavum (Say). Shelby County: my 801, a single fresh shell, part of epidermis still intact. East Hamilton Scenic Area, Sabine National Forest, 9 miles east of Patroon, Texas. This represents a range extension of 200 miles from Logan County, Arkansas, the nearest locality for live material, and 150 miles from the loess record at Natchez, Mississippi. The specimen is from the ecotone of the Sabine River bottoms and the pine-hardwood forest. Additional collecting will be needed before any statement as to the extent of *Haplotrema* range in Texas

can be made. It was found in association with *Mesodon thyroidus* and *Anguispira alternata crassa*.

Anguispira alternata crassa Walker. Cass County: my 704, 3 fresh shells, 2 February, 1963, bottoms of the Sulphur river 1.7 miles north and 1.7 miles west of Domino, Texas. Shelby County: my 800, one live and two fresh shells, under logs, pine-hardwood forest, East Hamilton Scenic Area, Sabine National Forest, 9 miles east of Patroon, Texas, 28 September, 1963. *A. a. crassa* has been recorded from Caddo and De Soto parishes in Louisiana on the Texas border, but not previously from Texas. The range of this subspecies in Texas cannot be determined without extensive collecting. *A. a. strongylodes* occurs as far north and east as Dallas County and they may intergrade on the western edge of the pine-hardwood forest.—WILLIAM LLOYD PRATT, JR., 4501 El Campo, Ft. Worth, Texas.

SOME TEXAS LOCALITIES FOR HELICIDAE.—Pilsbry (Land Mollusca 1 (1), 1939) recorded no helicid snails from the state of Texas. More recently Grimm (*Nautilus* 77 (3):108-109) reported *Otala lactea* from Port Arthur, Jefferson County, Texas. The purpose of this note is to record additional localities for this species and to report the presence of two additional species in the state.

Otala lactea (Müller). Galveston County: my 182, 16 live and fresh shells, garden of Galvez Hotel, Galveston, Texas, 8 December 1961. Brazos County: Mr. David Christopher has found this snail in several localities around College Station, Texas. Tarrant County: A single specimen (FWCM. 121) in the collection of the Fort Worth Children's Museum. It was found crossing the street in front of the museum in the early morning during a rain by Mr. Robert Millican, the building engineer, during December, 1962. Extensive search in the area has not yielded further specimens and this may be a chance import.

Otala vermiculata (Müller). Galveston County: my 292, two adult shells, having the same data as *O. lactea* reported above.

Helix aspersa Müller. Tarrant County: my 804, two live snails found in a nursery during December, 1963, by Mr. F. J. Pratt. The owner says that they are found annually on freshly arrived rose bushes from California. They apparently have not become established. Dallas County: I have seen one specimen reportedly found on the outside wall of a residence in Dallas, fall, 1962.

I have no further information nor have I seen additional specimens.—WILLIAM LLOYD PRATT, JR., 4501 El Campo, Ft. Worth, Texas.

CARUNCULINA (LAMPSILINAE)—*Carunculina* "Simpson" F. C. Baker, 1898, Chicago Acad. Nat. Sci., Bul. 3, is the legal spelling, for the following reasons: 1. The original publication gave alternative spellings, *Corunculina* (p. 109) and *Carunculina* (in the index). [Incidentally another, nearby heading is an obvious misprint; "Euryma" (p. 100) is correctly *Eurynia* in the index.] 2. Simpson, 1900, Proc. U. S. Nat. Mus. 22: 563, preferred *Carunculina* and thus determined the correct spelling. Nevertheless, according to article 51 (c), the authority for *Carunculina* is not "Simpson in Baker" but Baker, because Simpson contributed nothing to the "validating conditions" in the original publication. The only reason it dates from 1898 is due to the fact that F. C. Baker included in it one species, *Lampsilis parvus* (Barnes), which automatically becomes its type. Of course, its first description was published by Simpson (1900) who (illegally) chose *Unio texasensis* Lea.—H. B. B.

ELLIPTIO FEMININE.—*Elliptio* Rafinesque, 1819, J. de Phys., etc. 38: 426, although usually treated as a masculine noun, apparently should be employed as a feminine one. Rafinesque, 1820, Ann. Gén. Sci. Phys. Bruxelles 5: 291-295, consistently used *Elliptio* as feminine (e.g. *E. nigra*), although this may have been due to the fact that he erroneously treated *Unio* as such. However, *unio* (onion) was a concrete noun (masculine) while *Elliptio* (elliptic?) has more the form of an abstract compound (feminine).—H. B. B.

PUBLICATIONS RECEIVED

Powell, A. W. B. 1964. The Family Turridae in the Indo-Pacific. Part. The subfamily Turrinae. Indo-Pacific Mollusca 1 (5): 227-346, pls. 172-262 (3 in color).—35 genera and 177 species, recent and Tertiary treated, of which 13 are new. The editor (not the author) erroneously interchanged the figures in plates 248 and 249, and figures 1 and 2 in plate 240. Replacement pages will be sent subscribers.

Parker, Robert H. 1963. Zoogeography and ecology of some macro-invertebrates, particularly mollusks, in the Gulf of

- California and the continental slope off Mexico. Vidensk. Medd. fra Dansk naturh. Foren. 126: 1-178, pls. 1-15.
- Cotton, Bernard C. 1964. South Australian Mollusca—Chitons. Handbook of the flora and fauna of South Australia, 151 pp., 139 figs., 1 color plate. A revision of Cotton and F. K. Godfrey's 1940 handbook on the chitons.
- Altena, C. O. van Regteren. 1958. De Landmollusken van de Sint-Pietersberg. Naturh. Maanbl. 47: 86-98.—Dutch province of Limburg.
- Araujo, J. L. de Barros. 1963. Sobre *Anostoma* (*Ringicella*) *ringens* (L., 1758) (Gastropoda, Pulmonata, Odontostomidae). Mem. Inst. Oswaldo Cruz 61: 149-152, 7 figs.—Anatomy and shell.
- Basch, Paul F. 1963. A review of the recent freshwater limpet snails of North America. Bul. Mus. Comp. Zoo. 129: 401-461, 20 figs.—Shells and anatomy.
- 1963. Environmentally influenced shell distortion in a fresh-water limpet. Ecology 44: 193-194, 1 fig.
- Bentham Jutting, W. S. S. van. 1962. Selection of lectotypes of non-marine Mollusca of New Guinea, described by Tapparone Canefri, and now preserved in the Museo Civico di Storia Naturale 'Giacoma Doria' in Genoa. Ann. Mus. Civ. Sto. Nat. Genova 73: 1-8, 10 figs.
- 1963. Non-marine Mollusca of west New Guinea. Part 1, Mollusca from fresh and brackish waters. Nova Guinea, Zoo. 20: 409-521, 56 figs. & pls. 24-25.—New species are included in *Bellamyia*, *Fluviopupa*, *Clenchiella*, *Taheitia*, *Stenothyra*, *Gabbia*, *Tatea*, *Hemistomia*, *Assimineia*, *Acmella*, *Omphalotropis*, *Melanoides*, *Physastra*, *Gyraulus* and *Anisus*.
- 1963. Part 2, operculate land shells. Nova Guinea, Zoo. 23: 653-726, 3 text-figs., pls. 27-30.—New species are added to *Hydrocena*, *Sulfurina*, *Pleuropoma*, *Lagochilus*, *Ditropis*, *Pupinella*, *Bellardiella*, *Pupina*, *Moulinsia*, *Palaina*, *Pseudocyclotus* and *Dominamaria*.
- Blinn, Walter C. 1963. Ecology of the land snails, *Mesodon thyroidus* and *Allogona profunda*. Ecology 44: 498-505, 2 figs.—Seasonal histories and activities.
- Clarke, Arthur H., Jr. 1963. Arctic archibenthal and abyssal molluscs dredged from Drifting Station Charlie (Alpha 2). Nat. Mus. Canada Bul. 185: 90-109, incl. 41 figs. & 2 pls.—



External views of the right valves. Fig. 1 *Tellina magna* Spengler. Fig. 2. Hybrid specimen. Fig. 3. *T. laevigata* Linnaeus. (All about $0.85\times$).

Alvania karlini is proposed.

- & Anne Meachem Rick. 1963. Supplementary records of Unionacea from Nova Scotia with a discussion of the identity of *Anodonta fragilis* Lamarck. Nat. Mus. Canada Bull. 199: 15-27, incl. 1 pl. and a map.
- Clayton, Lee. 1961. Late Wisconsin Mollusca from ice-contact deposits in Logan County, North Dakota. Proc. N. D. Acad. Sci. 15: 11-18, 2 figs.
- Clench, William J. 1962. New species of land mollusks from the Republica Dominicana. Breviora M. C. Z. no. 173: 1-5, 1 pl.— New species are added to *Helicina*, *Proserpina*, *Geomelania* and *Zaphysema*.
- 1963. Land and freshwater mollusks of the Crooked Island group, Bahamas. Bul. Mus. Comp. Zoo. 128: 395-413, 3 pls. New species are included in *Eutrochatella*, *Opisthosiphon*, *Microceramus* and *Plagioptycha*.
- Dazo, Bonifacio C. & Ricardo G. Moreno. 1962. Studies on the food and feeding habits of *Oncomelania quadrasi*, the snail intermediate host of *Schistosoma japonicum* in the Philippines. Trans. Amer. Micr. Soc. 81: 341-347, 2 figs.
- Forcart, Lothar. 1961. Spedizione biologica in Somalia dell' Universita die Firenze, 1959. Risultati zoologici, 5, Mollusca. Monit. Zoo. Ital. 69: 39-45.—Inland mollusks.
- Getz, Lowell L. 1962. *Pomatiopsis cincinnatiensis* and *P. lispidaria* as potential intermediate hosts of *Schistosoma japonicum*. J. of Parasit. 48: 498-499.
- Ghose, Krishna Chandra. 1962. Origin and development of the digestive system of the giant land snail *Achatina fulica* Bowdich. Proc. Roy. Soc. Edinburgh 68 (pt. 3): 186-207, 19 figs.
- 1963. The alimentary system of *Achatina fulica*. Trans. Amer. Micr. Soc. 82: 149-167, incl. 1 fig. & 2 pls.
- 1962. Morphogenesis of the nervous system in the giant land snail *Achatina fulica* Bowdich. Zoo. Anz. 169: 467-475, 16 figs.
- 1961 & 1962. Morphogenesis of the statocyst in the giant land snail *Achatina fulica*. J. Univ. Bombay 30: 77-79, incl. pl. 1.
- 1961 & 1962. Morphogenesis of the eye in the giant land snail, *Achatina fulica*. J. cit.: 73-76, incl. pl. 1.
- 1962. Morphogenesis of the pedal gland in the giant land

- snail, *Achatina fulica* Bowdich. Current Sci. 32: 167-168, 4 figs.
- 1962. Organs of special senses in *Achatina fulica*. J. Anim. Morph. & Physiol. 9: 131-134, 1 pl.
- 1963. Reproductive system of the snail *Achatina fulica*. Proc. Zoo. Soc. London 140: 681-695, 1 fig., pls. 1-2.
- 1963. Embryogenesis and larval organs of the giant land snail *Achatina fulica* Bowdich Proc. Roy. Soc. Edinburgh, sect. B, 68: 237-260, 25 figs.
- 1962. The cleavage, gastrulation and germ layer formation in the giant land snail, *Achatina fulica*. Proc. Zoo. Soc. [Calcutta] 15: 47-54, pl. 4.
- Habe, Tadashige. 1962. Trichotropidae in Japan (Mollusca). Bul. Nat. Sci. Mus. (Tokyo) 6: 67-77, 5 figs, pl. 7.—*Trichamathina* (n. gen.) and new species of *Iphinoe*, *Turritropis*, *Akibumia* & *Amamiconcha* are included.
- Henrard, J. B. Year? A new species of *Pseudobba* (Mollusca, Gastropoda) from western New Guinea. Zoo. Meded. Rijksmus. Nat. Hist. Leiden 39: 308-310, 1 fig.
- Hubendick, Bengt. 1962. Aspects on the diversity of the freshwater fauna. Oikos (Copenhagen) 13: 249-261, 3 figs.—Limnic & hololimnic.
- Kawaguti, Siro & Noriaki Ikemoto. 1962. Electron microscopy on the mantle of a bivalve, *Musculus senhousia* during regeneration of the shell. Biol. J. Okayama Univ. 8: 31-42, 17 figs.—All 3 layers of the shell are mended.
- Klappenbach, Miguel A. Una nueva especie de *Cyclodontina* del Uruguay (Gastr. Pulm.). Com. Zoo. Mus. Hist. Nat. Montevideo 4 (81): 1-4, pls. 1-2.
- Loosjes, F. E. 1963. Supplement to a monograph of the Indo-Australian Clausiliidae. Zoo. Med. Rijksmus. Nat. Hist. Leiden 39: 153-169, 5 figs, pl. 5—New species are added to *Pseudonebia* & *Acrophaedusa*.
- 1963. Clausiliidae collected by the Netherlands Biological Expedition to Turkey in 1959. Med. cit.: 242-260, 2 figs., pls. 18-20. New species are proposed in *Euxinastra* & *Acrotoma*.
- MacClintock, Copeland. 1963. Reclassification of gastropod *Proscutum* Fischer based on muscle scars and shell structure. J. of Paleont. 37: 141-156: 141-156, 31 figs., pl. 20.—Transferred to Patellinae.

THE NAUTILUS

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No. 2

NEW ENGLAND NUDIBRANCH NOTES

By HENRY D. RUSSELL

The following notes and table concerning the activities of the Nudibranch fauna of the Cape Cod region are the result of the author's observations while at the Marine Biological Laboratory at Woods Hole, Massachusetts from September 1962—September 1963. Certain species e.g. *Tergipes despectus* (Johnston) were abundant and were studied both in laboratory aquaria and in the field, while others e.g. *Idulia coronata* Gmelin or *Aeolidia papillosa* (Linné) were collected only once or twice. The species were discovered at widely different localities in the coastal waters of Cape Cod and/or the adjacent islands and at widely spaced intervals of time. This may help to explain some of the apparent inconsistencies of table 1 and indicates the need for further investigation.

Previous studies have shown that there are two chief breeding periods for northern New England nudibranch species—one in May and one in November. This contrasts with the findings for British species which breed chiefly in June, while those for Ireland breed chiefly in August and September. The species of the Cape Cod region, however, start slightly ahead of those in northern New England in this respect in that breeding and egg-laying begins in late March. After egg-laying, many of the species appear to be exhausted from the effort and die.

The species are presented more or less in systematic order rather than in accord with their seasonal occurrence and their activities are summarized in table 1.

Elysia chlorotica Gould

On July 2 and 17 specimens of *Elysia chlorotica* Gould were collected abundantly on *Vaucheria* sp. upon which they apparently were feeding. The alga was growing on the mud banks of tidal inlets in the Barnstable marshes. *E. chlorotica* did not seem to be breeding and no egg masses were found. They were exposed by the receding tide to an air temperature of 37.0°C. Specimens were placed in running sea-water tanks in the laboratory and

Table 1
Summary of Species' Activity

Species	Period of egg laying	Period of veliger hatching	Egg laying to hatching days	Dates. Adults	water°C.
<i>Elysia chlorotica</i>		7/29		7/2-8/9	+22.0
<i>Aeolidia papillosa</i>	--	--	--	October	--
<i>Cratena aurantia</i>	4/23-6/10	5/22-6/10	29	3/25-7/1	4.0-16.5
<i>Cratena concinna</i>	3/9-5/15	4/16-5/15	6	1/15-5/15	4.0-14.0
<i>Embletonia fuscata fuscata</i>	6/-	6/-	-	6/17-	18.8
<i>Tergipes despectus</i>	3/19-5/28	3/29-6/-	10-14	3/19-6/3	4.0-21.0
<i>Coryphella pellucida</i>	5/1-5/10	5/13-5/22	13	4/30-5/24	6.0-14.0
<i>Idulia coronata</i>	6/14-	6/17-	+3	5/6-6/14	4.4-14.4
<i>Dendronotus frondosus</i>	--	--	--	4/16-	10.0
<i>Onchidoris aspera</i>	--	--	--	8/9-	16.5
<i>Onchidoris fusca</i>	5/27-6/27+	6/3-	7	5/27-6/-	16.0-21.5

egg coils containing young in the veliger stage were observed on July 25.

Collecting again in the Barnstable marshes on August 9, only a few specimens were seen, most of the *Vaucheria* sp. had disappeared and only a few scattered patches were found. No egg masses were seen. The marshes had been heavily and aerially sprayed at least twice, on July 17 and August 9, for greenhead flies, *Tabanus* sp., control with 0.2% malathion. This may or may not have influenced the presence or absence of *E. chlorotica* at the time of field observation in August. It is quite possible that the life cycle terminates naturally at about this time after oviposition.

Aeolidia papillosa (Linné)

One adult specimen of *Aeolidia papillosa* (Linné) was found in the running seawater table of the Laboratory in October. It apparently had developed in the salt-water tanks located on the roof of the laboratory and had come down through the salt-water system.

Cratena aurantiaca (Alder and Hancock)

The following sequence of events outlines some of the activities of *Cratena aurantiaca* (Alder and Hancock) from March to July. Specimens were found on the hydroid, *Parypha crocea*, both when it was growing just below low tide on wharf pilings or

dredged at a depth of 60 feet in Vineyard Sound, southeast of Job's Neck, Naushon Island. Alder and Hancock¹ report that the eggs are laid on the Northumberland coast in June and July. The first specimens taken by the author appeared to be carrying eggs on March 25 when the water temperature from which the 8-10 mm. animals were taken was 4.0°C. Adults were placed in jars with running sea-water in the laboratory and preferred to remain deep among the stalks of *P. crocea* where they might easily have been overlooked. They spend their time here, lay their white, kidney-shaped, 3mm.-long egg masses here and emerged only when the water became foul or the hydroid died. They apparently feed on the hydroid, though this was not observed.

Egg masses were first recorded on April 23 in the 16-celled stage. The young veligers showed signs of motion within the egg capsule on May 6, but did not hatch until May 22. The water temperature was 14.0°C. The hatching of the veligers continued through June 10 and the adults continued to lay eggs. The observations were terminated by July 1 as no more egg masses were produced. The hydroid *P. crocea* and the specimens had died.

Cratena concinna (Alder and Hancock)

The first few 12+ mm. specimens were observed on the hydroid, *Thuiaria argentea* growing on stones under the bridge at Sengecontacket Pond, Martha's Vineyard, on January 15. No eggs were observed at this time. On April 9, eight 18 mm. specimens were dredged in 60 feet of water in Vineyard Sound southeast of Job's Neck, Naushon Island. They were laying irregular cream-white-pinkish egg coils and in some the veligers were active and approaching hatching. Eggs laid in a jar of running seawater at a temperature of 10.0°C. on April 16 were seen to be active and in the veliger stage two days later and to be hatching by the 22nd.

Egg laying appears to take place during March and into May as the water warms from 4.0°C.—14.0°C. Development to the veliger stage and their hatching takes place during this period also.

Embletonia fuscata fuscata Gould

On June 17 two adult specimens of *Embletonia fuscata fuscata* Gould were observed in Wellfleet Harbor on the hydroid,

¹ Monograph of the British Nudibranchiate Mollusca, Family 3, 1851.

Obelia commisuralis. The water temperature was 18.8°C and the 0.5-1mm. rounded to kidney-shaped egg capsules were scattered along the stalks and branches of the hydroid. The young appeared to be in the veliger stage, nearing hatching. Eggs were visible through the body wall of the adults also. The observation of ova in July was reported in 1870 by A. A. Gould and W. J. Binney in Report on the Invertebrata of Massachusetts, p. 252.

Tergipes despectus (Johnston)

Adults, deposition of egg masses and hatching of veligers of *Tergipes despectus* (Johnston) were observed on the hydroid, *Laomedea loveni* (Allman) growing on a wharf in the Eel Pond at Woods Hole. The animals 3-10.5 mm. in length were discovered with kidney-shaped egg masses on March 19. The water temperature was 4.0°C and the nudibranchs were feeding on the hydroid by rasping a hole at the base of the hydrotheca and drawing the hydranth through it into the mouth — tentacles last.

On March 29, the young laid on March 19 left their disintegrating gelatinous egg capsule and swam freely in the sea-water. Egg laying continued from the middle of March until the end of May at which time the water temperature was 17.0°C and by June 3 only one adult was seen on the wharf and no eggs were found. The water temperature was then 21.0°C.

In the laboratory, egg masses laid on April 18 and 25 hatched on May 2 and 6 respectively in a water temperature of about 10.0°C, while in the Eel Pond egg laying continued as the temperature changed from 4.0°-17°C over a period of 2½ months.

An examination of the wharf on July 10 showed that the *Laomedea loveni* (Allman) had disappeared, having reproduced during June.

Coryphella pellucida (Alder and Hancock)

On one of the running salt-water tables in the laboratory, several specimens of *Coryphella pellucida* (Alder and Hancock) were first observed on April 30. They ranged in size from 1.5—15.0 mm., were feeding on the hydroid, *Eudendrium* sp. and on it an irregular, pinkish coil of eggs was laid. The water temperature was 4.0°C. The young reached the veliger stage on May 6 and hatched on May 13 when the water temperature was 6.0°C. in their aquarium. Egg masses were deposited from May 1-10. The majority of veligers had hatched by the 15th and were dead

by the 24th, probably due to starvation and/or being caught in the surface film.

Idulia coronata (Gmelin)

Two adult *Idulia coronata* (Gmelin) were found on the hydroid, *Obelia commisuralis* on May 6 in water of 8.5°C. The hydroid was growing on wharf timbers in the Eel Pond at Woods Hole. No egg masses were observed at this time. On June 14, several adults depositing eggs were found on *Obelia* sp. growing on the south breakwater at the eastern end of the Cape Cod Canal. The water temperature was 4.4°C. Three days later a young, 1 mm., specimen was located on the hydroids and the egg masses contained active veligers that appeared near the hatching stage.

Dendronotus frondosus (Ascanius)

A 25 mm. specimen of *Dendronotus frondosus* (Ascanius) was found on a wharf timber in the Eel Pond on April 16 in water whose temperature was 10.0°C. No egg masses were observed.

Onchidoris fusca (Müller)

An adult *Onchidoris fusca* (Müller) about 25 mm. long was observed feeding on the barnacle, *Balanus balanoides*, in a laboratory running sea-water table on May 13. A coil of eggs was laid on May 27 and active veligers were found on it. By June 3 many had hatched into the 16.0°C water and on the following day "rafts" of dead and dying veligers were found caught in the surface film.

The two largest specimens measuring 37 x 25 mm. and 31 x 18 mm. had died by June 27, but two smaller ones 25 x 18 mm. and 18 x 12 mm. were alive and appeared to be breeding in the 21.5°C water.

Onchidoris aspera (Alder and Hancock)

Several specimens were found August 9 on the seaweed, *Chondrus crispus*, growing on the south breakwater at the eastern end of the Cape Cod Canal. They ranged in length from 2—3 mm. and were in water at 16.5°C.

Table 1 contains many blank or incompletely recorded spaces, showing the critical need for further collecting, species study, both in the laboratory and its comparison with individuals in the field, and the compilation of the resulting data to point the way for future research.

The overlapping dates and variety of water temperatures may

appear to be troublesome in pin-pointing or comparing species activity. This apparent discrepancy may be explained by the facts that species were collected or studied in water temperatures observed at as widely different localities as the Cape Cod Canal, Wellfleet, Woods Hole or Martha's Vineyard and that species often already were engaged actively in egg-laying, for example, when discovered in the field.

BIBLIOGRAPHY

1. Alder, J. and A. Hancock, 1845-51. British nudibranchiate Mollusca, pts 1-8 with Supplement by Sir Charles Eliot.
2. Gould, A. A. and W. G. Binney, 1870. Report of the Invertebrata of Massachusetts, pp. 225-258, text figs. 516-521, pls. 16-22.
3. Johnson, C. W. 1934. List of the marine Mollusca of the Atlantic coast from Labrador to Texas. Proc. Boston Soc. of Nat. Hist. 40, No. 1, pp. 1-204.

REACTIONS OF HOSTS TO PROBOSCIS PENETRATION BY ODOSTOMIA SEMINUDA (PYRAMIDELLIDAE)

By ARTHUR S. MERRILL¹ AND KENNETH J. BOSS²

Ectoparasitic pyramidellids occur on a wide variety of hosts (see Robertson and Orr, 1961, for review of the literature). Also documented is the fact that prolonged parasitization by pyramidellids may interfere with the normal development and growth of the host (Cole and Hancock, 1955; Loosanoff, 1956). The immediate reactions of hosts to the stimulus of proboscis penetration by ectoparasites are less well known. One of the purposes of this paper is to describe and illustrate these reactions.

The work of Cole and Hancock (1955) indicated that in the European oyster, *Ostrea edulis* Linnaeus, and in the common edible mussel, *Mytilus edulis* Linnaeus, mantle tissues are subject to considerable irritation by the penetration of the proboscides of parasitic gastropods. Constant irritation causes the withdrawal of the affected portions of the mantle and allows the ectoparasites to enter and live within the shell cavity of the host. The host often reacts by depositing a barrier of shell material, this resulting in local internal shell malformation. Cole and Hancock suggested that the oysters suffered a varying "loss of condi-

¹ Bureau of Commercial Fisheries Biological Laboratory, Woods Hole, Massachusetts.

² Bureau of Commercial Fisheries Ichthyological Laboratory, U. S. National Museum, Washington, D. C.

tion" and even death, depending upon the severity of attack. In general, Loosanoff (1956) reported similar effects in the American oyster, *Crassostrea virginica* (Gmelin). He further noted that the oyster soon becomes accustomed to prolonged localized parasitization and fails to close its valves even when under severe attack by several parasites at the same time.

Observations of actual proboscis penetration by *Odostomia impressa* (Say) have been made on *Crassostrea virginica* from which one valve had been removed (Allen, 1958; Wells, 1959). We employed this method using the ectoparasite, *Odostomia bisuturalis* (Say), in an attempt to observe the reactions of *C. virginica* to penetration. We were able to note clearly the long, thin, semi-transparent proboscis of *O. bisuturalis* extending to the somewhat retracted mantle of the oyster and to see the sucking and pumping action of the proboscis. However, we failed to detect any muscular reaction by the bivalve hosts when they were pierced. This we attributed to the probability that the oysters would not react normally after recently sustaining the shock of removal of one of their valves.

In order to make observations on the immediate reaction of normal hosts to proboscis penetration, it was necessary to find host animals that could be observed uninjured. The sessile gastropods, *Crepidula fornicata* (Linnaeus), *C. plana* Say, and *Crucibulum striatum* Say were selected because the external morphological features of the animals could be observed *in situ* without direct or tactile interference by the investigators. The host animals were allowed to adhere to glass plates and the *Odostomia seminuda* (C. B. Adams) (Plate 4, fig. 1.) were introduced among them. The entire procedure was done under water in glass aquaria. With the glass plate set on edge, both dorsal and ventral views of the host animals were easily obtained.

Our observations show that in most cases the proboscis of *Odostomia seminuda* penetrated the mantle of the host (Plate 5, fig. 1), although infrequently the proboscis would extend beyond to pierce the visceral mass (Plate 4, fig. 2). In either case proboscis penetration elicited from the host an immediate muscular response. Plate 4, fig. 2 pictures the withdrawal reaction exhibited by *C. fornicata* when it was being parasitized. Figure 3, in Plate 4 taken 2 two minutes after fig. 2, illustrates the gradual subsidence of the withdrawal reaction of the host after

the removal of the proboscis.

Cole and Hancock (1955), Allen (1958), and Robertson and Orr (1961), reported the gathering of ectoparasites around a single host. This was noted often during this study when hosts and parasites were placed randomly on glass plates. Plate 5, fig. 1 shows the dorsal and fig. 2 the ventral view of the same animal, *Crucibulum striatum* Say, with the concentration of *Odostomia seminuda* at the shell edge. The mantle of the *Crucibulum* is withdrawn in one area where the vague outline of a proboscis can be seen penetrating into it. These two species would not be found together in the natural environment since they are bathymetrically isolated; *Crucibulum striatum* is found in deeper water. Those used in this study were dredged during "Albatross IV" cruise 63-3, station 52, Great South Channel, near Nantucket Shoals, off Massachusetts (N. Lat. 40°37'; W. Long. 69°08'), in 37 fathoms. On the other hand, *O. seminuda* were collected in shallow water, 2-4 feet deep, near the mouth of the Bass River, West Dennis, Cape Cod, Massachusetts. Under laboratory conditions the two species form this strong association, which is herein reported for the first time.

Odostomia seminuda usually move about rather freely among a clump of *Crepidula fornicata*, but at times they aggregate around a single specimen. When observed in the field, most of the ectoparasites were near, or at the edge of the host's shell. Examination under a dissecting microscope showed the proboscis of *Odostomia* extending underneath *C. fornicata* in the manner described and figured by Robertson (1957). We often observed *O. seminuda* at the margin of the host but close examination showed that they were not always feeding. The peripheral interiors of several dozen shells of *C. fornicata* were inspected without finding any indication of shell malformation due to excessive parasitization of one area of the mantle. Since *C. fornicata* clamps its shell against the substrate as a reaction to the parasitization and since *O. seminuda* thereupon instantly withdraws its proboscis, there is little opportunity for extensive irritation.

We concur with Robertson (1957) that *Odostomia seminuda* feeds on *Crepidula fornicata* for only short periods at a time. A similar situation prevails in the small gastropods *Hydrobia* and *Rissoa* which are parasitized by *Odostomia scalaris* MacGillivray

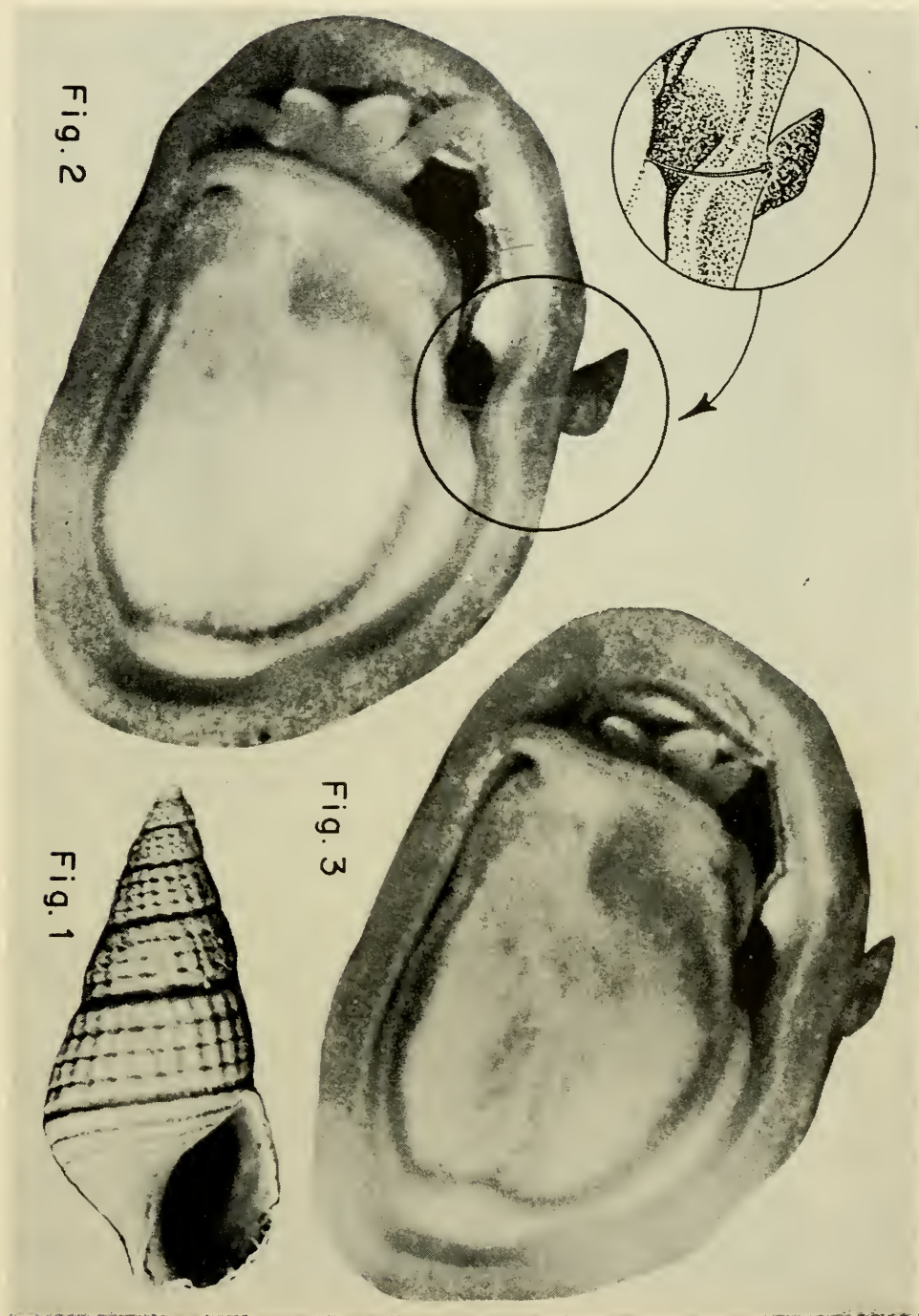


Fig. 1. *Odostomia seminuda* (C. B. Adams) (actual length 3.7 mm).
 Fig. 2. Ventral view of *Crepidula fornicata* Linnaeus with associated parasites, *Odostomia seminuda*. Proboscis penetration into the visceral mass is evident. Note contracted muscles in the area of penetration (length of *Crepidula* 30 mm). Fig. 3. Ventral view of *Crepidula fornicata* (photograph taken 2 minutes after the one in fig. 2). *Crepidula* has clamped tightly to the glass plate causing *Odostomia* to withdraw its proboscis. Muscles are less contracted, especially in the mantle.

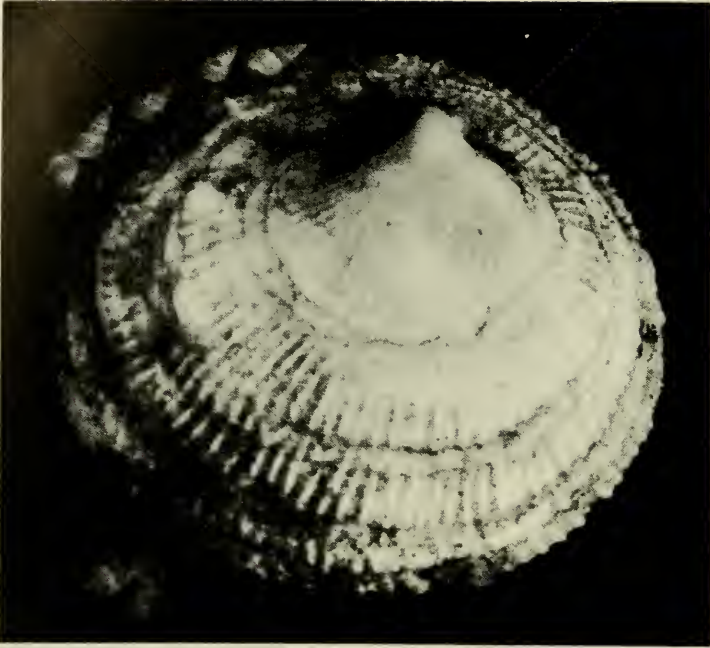


Fig. 1

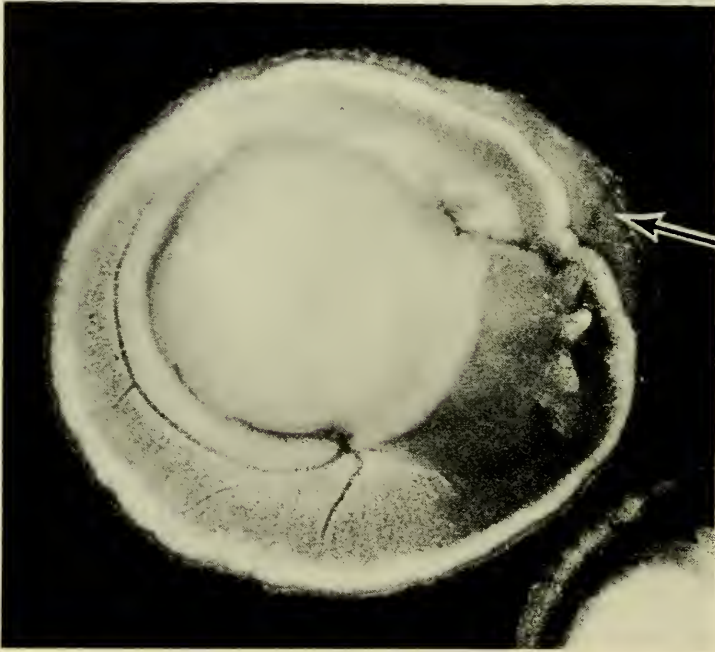


Fig. 2

Fig. 1. Dorsal view of *Crucibulum striatum* Say with a concentration of *Odostomia seminuda* C. B. Adams along the shell edge (length of *Crucibulum* 35 mm). Fig. 2. Ventral view of same animal of *Crucibulum striatum* showing the withdrawal reaction of the mantle. Note the vague outline of a proboscis (arrow) penetrating the mantle at its point of greatest withdrawal.

(= *rissoides* Hanley). According to Ankel and Christensen (1963), these hosts seldom allow the parasites to feed for periods of more than a few seconds before they retract into their shells. The persistence of the parasites enables them to be successful in their attacks on *Crepidula*, *Crucibulum*, *Hydrobia*, and *Rissoa*.

REFERENCES CITED

- Allen, J. F. 1958. Feeding habits of two species of *Odostomia*. *Nautilus* 72: 11-15.
- Ankel, F. and A. M. Christensen. 1963. Non-specificity in host selection by *Odostomia scalaris* MacGillivray. *Vidensk. Medd. fra Dansk naturh. Foren.* 125: 321-325.
- Cole, H. A. 1951. An *Odostomia* attacking oysters *Nature* 168: 953-954.
- Cole, H. A. and D. A. Hancock. 1955. *Odostomia* as a pest of oysters and mussels. *J. Mar. biol. Ass. U. K.* 34: 25-31.
- Loosanoff, V. L. 1956. Two obscure oyster enemies in New England waters. *Science* 123: 1119-1120.
- Robertson, R. 1957. Gastropod host of an *Odostomia*. *Nautilus* 70: 96-97.
- Robertson, R. and V. Orr. 1961. Review of pyramidellid hosts, with notes on an *Odostomia* parasitic on a chiton. *Nautilus* 74: 85-91.
- Wells, H. W. 1959. Notes on *Odostomia impressa* (Say). *Nautilus* 72: 140-144.

NOTES ON SPHAERIID NAMES

By H. BURRINGTON BAKER

Recently, using H. B. Herrington's very helpful monograph (1962) and the typewritten slips, which I think represent his careful identifications, the Sphaeriidae in the Academy of Natural Sciences of Philadelphia have been rearranged and labeled. The following notes on nomenclature may be of interest to others.

SPHAERIIDAE, 1820.

According to article 40 (b) of the 1961 "code," the generally accepted, familial name Sphaeriidae dates from Cycladia Rafinesque (1820). However, Pisidiadae Gray in Turton (1857) is apparently prior to any use of Sphaeriidae as such. [Bourguignat, 1883, employed Sphaeridae, and Dall, 1895, Sphaeriidae.] For the same reason, the superfamily Sphaerioidea also is dated from 1820, and thus is prior to Corbiculidae, which would go back to Cyrenidae Gray, 1840 [Corbiculadae Gray, 1847]. [Vernaculars (outlawed by article 11, b) have not been checked.]

SPHAERIUM SIMILE, 1816.

Herrington (1950) in his discussion of *Cyclas similis* Say (1816) seems to have been a bit confused. In bivalves, Say, like many of his contemporaries, for example Isaac Lea, used "breadth" to mean what we now call length, and employed "length" for what we term height. They used diameter much as we do. This means that the missing type of *similis*, as Say measured it, was about 10.2 mm. long and 8.9 mm. in height (87% of length).¹ However, Say's figure is more elongate; I make it about 11.4 x 8.4 mm., so that its height appears to be only 74% of its length, which brackets the usual proportions of this species, described from the Delaware River. Furthermore, Say indicated that one of his shells measured nearly 15.2 mm. in height, which, using the same proportion as his dimensions, means at least one valve about 17 mm. in length, or, applying the shape of his figure, one about 20 mm. long.²

Partly for these reasons, I agree with F. C. Baker (1898) that *Sphaerium simile* (Say) is the prior name of what Herrington (1962: 28) called *S. sulcatum* (Lamarck). Incidentally, *S. simile* is not a "nomen oblitum."

SPHAERIUM OCCIDENTALE, 1856.

Following Prime in subsequent works, *S. occidentale* usually is dated from him (1860). However, at that place, he also cited *Cyclas occidenalis* "Pr." Lewis (1855 & 1856). Actually in 1855, the name was nude, but in 1856, Lewis vested it with the indication: "20. *C. occidentalis*, Prime (*ovalis* Pr., formerly)." Since to call this well known "*Musculium*" a "nomen oblitum" would be quibbling, it apparently should be cited as *Sphaerium occidentale* (Lewis) or more completely ("Prime" Lewis, 1856).

SPHAERIUM FABALE, 1851.

The type specimen of *Cyclas edentula* Say (1829) is this species, but apparently that prior name, which was considered a synonym of *S. striatinum*, is now a "nomen oblitum."

REFERENCES

- Baker, Frank Collins. 1898. The Mollusca of the Chicago area. Bul. Chicago Acad. Sci. no. 3: 116.

¹ A shell of these dimensions may not be "juvenile." Foster (1932) proved that a *Sphaerium* of the same group (*Amesoda* Raf.) becomes sexually mature before it attains half the maximum size of its sterile senility. Apparently growth is continuous until death.

² It might have died of old age, and been too eroded for description.

- Foster, Thural Dale. 1932. J. of Morphology 53: 490. [On *S. solidum*, identified by Sterki.]
- Herrington, H. B. 1950. Naut. 63: 117-118.
- 1962. A revision of the Sphaeriidae of North America (Mollusca: Pelecypoda). Misc. Publ. Mus. Zoo. Univ. Mich. no. 118.
- Lewis, James. 1855. Proc. Boston Soc. Nat. Hist. 5: 122.
- 1856. Proc. cit. 6: 2.
- Prime, Temple. 1860. Proc. Acad. Nat. Sci. Philadelphia 12: 295.
- Rafinesque, M. C. S. 1820. Ann. Gén. Sci. Phys. Bruxelles 5 (13): 318.
- Say, Thomas. 1816. Nicholson's Encyclopedia. American Edition (first) 4: pl. 1, fig. 9. [Not paginate; only photostat seen.]
- 1829. New Harmony Diss. 2: 356.
- Turton, William. 1857. Manual of the land and fresh-water shells of the British Islands. New edition, with additions by John Edward Gray. Pages xvi & 263.

LITTER SIZE IN THE SPHAERIIDAE

By WILLIAM H. HEARD

Florida State University, Tallahassee

Ovoviviparity is a familiar character of sphaeriid clams, and the comparative differences in the number of embryos contained in a single developing litter have been used in support of *Musculium* Link as a valid genus apart from *Sphaerium* Scopoli. Gilmore (1917) found that the majority of gravid *Sphaerium simile* (= *S. sulcatum*) contained 2 embryos while a few supported 4, and Foster (1932) reported 2 to 4 embryos for *S. solidum* (= *S. striatinum*). Gilmore (1917) also listed up to 16 embryos per litter in *Musculium truncatum* (= *M. partumeium*), and Van Cleave, Wright and Nixon (1947) reported 8-18 embryos, and Thomas (1959) recorded up to 21 for the same species.

While it is generally conceded that *Sphaerium* has a smaller litter size than *Musculium*, little information has been available concerning the numbers of young produced by species in the other sphaeriid genera.

On June 3, 1962, I made a collection of 144 pisidia from Ore Creek at U.S. Hwy. 23 near Hartland Road, Livingston County, Michigan. Each individual was isolated in the field in the method developed by Dr. F. E. Eggleton of the University of Michigan: a single living clam was placed in a 1/2-ounce screw-capped bottle filled with pond water. The collection was then left until the

body tissues had decayed, leaving intact the shells of the adult and any post-dissoconch embryos present in that individual of that species. The data from this collection are summarized below.

IDENTIFICATION	NO. EXAMINED	NO. GRAVID	NO. EMBRYOS (RANGE)	NO. EMBRYOS (AVERAGE)
<i>Pisidium adamsi</i>	15	15	10-66	25.47
<i>P. casertanum</i>	106	102	0-53	15.00
<i>P. compressum</i>	23	23	11-49	22.23

Seven of 8 specimens of *P. variabile* collected on June 3, 1961, from Fleming Creek at Cherry Hill Road, Washtenaw County, Michigan, were gravid. Litter size ranged from 12 to 34, and the average was 27.8.

Dried museum specimens (University of Michigan Museum of Zoology No. 65282) of *Eupera cubensis* collected on April 23, 1935, from the Pasion River at Sayaxche, Dept. Peten, Guatemala, were immersed in a saturated solution of tribasic sodium phosphate for several days. This treatment essentially rehydrated the dried tissues still adhering to the interior of the valves, allowing one easily to dissect out any shelled embryos present. Litter sizes of 31, 25, and 35 were observed among 7 specimens examined.

A preserved collection (September 8, 1952) of *Eupera platen-sis* Doello-Jurado from Lagunas del Arroyo Malabrigo, 5 km. N. of Romang, Sante Fe, Argentina, was recently given to me by Dr. J. J. Parodiz of the Carnegie Museum. Gross dissection of nine animals revealed litter sizes of 37, 66, 56, 30, 45 and 22 in the six individuals that were gravid.

It is apparent that high rather than low litter sizes are to be expected in *Pisidium* C. Pfeiffer and *Eupera* Bourguignat as well as in *Musculium* Link. There is unfortunately no information at present concerning the reproductive habits of *Pseudocorbicula* Dautzenburg and *Byssanodonta* Orbigny. The evolutionary significance of different litter sizes and of different numbers of litters produced in *Pisidium* will be the subject of a more detailed future report.

LITERATURE CITED

- Foster, T. D. 1932. Observations on the life history of a finger-nail shell of the genus *Sphaerium*. J. Morphol. 53: 473-497.
 Gilmore, R. J. 1917. Notes on reproduction and growth in certain viviparous mussels of the family Sphaeriidae. Nautilus

31: 16-30.

Thomas, G. J. 1959. Self-Fertilization and production of young in a sphaeriid clam. *Nautilus* 72: 131-140.

Van Cleave, H. J., A. G. Wright, and C. W. Nixon. 1947. Preliminary observations on reproduction in the molluscan genus *Musculium*. *Nautilus* 61: 6-11.

REPRODUCTION OF *NASSARIUS TRIVITTATUS* OFF THE COAST OF GEORGIA

By RUDOLF S. SCHELTEMA*

Woods Hole Oceanographic Institution, Woods Hole, Massachusetts

Recently evidence for the reproduction of *Nassarius trivittatus* Say off the southern coast of Georgia was obtained when on April 2, 1964, its egg capsules were collected on the outer beach of Jekyll Island. The specimens were attached to the horny axial skeleton of a gorgonian coral. No eggs or embryos were contained in the capsules indicating that reproduction off the Georgia coast had probably been going on for some time, possibly since early March. The average length of the egg capsules was between 1.5 and 2.0 mm. and hence they probably were laid by a small individual. The egg capsules of *N. trivittatus* are to be distinguished from those of *Nassarius obsoletus*, the intertidal form, by several characters already described in a previous paper (Scheltema and Scheltema 1964, in press).

The southernmost distribution of the New England basket-shell, *N. trivittatus* is uncertain because of the lack of off-shore dredge samples. Abbott (1954) considers the species to extend from Nova Scotia to South Carolina whereas Bousfield (1960) more recently has indicated a range from Gaspé Bay, Quebec and western Newfoundland to Florida. The southernmost specimens represented in the collection of the Museum of Comparative Zoology, Harvard University, which appear to have been collected alive are those from off the coast of South Carolina, although there are several records of shells picked up along the shoreline as far south as Key West. The recovery of egg capsules in Georgia gives evidence for the occurrence of a reproducing population of *N. trivittatus* at that latitude (*ca.* 31°N.) and is of especial interest because of the apparent uncertainty of the southern limit of this species.

* Contribution No. 1496 Woods Hole Oceanographic Institution.

REFERENCES

- Abbott, R. T. 1954. American Seashells. Van Nostrand and Co., New York, xiv, 541 pp.
- Bousfield, E. L. 1960. Canadian Atlantic Sea Shells. Nat. Mus. Canada (Dept. North. Affairs and Nat. Resources) v, 72 pp.
- Scheltema, R. S. and A. H. Scheltema. 1964. Pelagic larvae of New England intertidal gastropods. III *Nassarius trivittatus*. Hydrobiologia (in press).
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THE LAND MOLLUSKS OF SIESTA KEY,
SARASOTA COUNTY, FLORIDA

By LANDON T. ROSS

Department of Geology, Florida State University, Tallahassee

The land mollusks of Siesta Key are of considerable interest. Any survey of the land snails on the mainland in this region will reveal a much smaller number of species living there than on adjacent islands. This is explained by the fact that many of the species involved are found living only near shore lines. Most of the islands along the west coast of Florida were formed in Quaternary time by the depression of an earlier shore line or, possibly, by a rise in sea level and many of the snails then living along the shore line were trapped on the newly formed islands. Most of these species have not, as yet, succeeded in spreading to the mainland.

Siesta Key is a small island forming the southwestern boundary of Sarasota Bay on the west coast of Florida. It is approximately 7.3 miles long with a maximum width of about 1.4 miles at the northern end. The soil is usually white quartz sand, often only a few feet thick and overlying unconsolidated coquina rock. There are some areas of uncleared vegetation which consist mainly of cabbage palm (*Sabal palmetto*), saw palmetto (*Serenoa repens*), and live oak (*Quercus virginiana*). The beaches along the Gulf of Mexico commonly have a sand ridge behind them with a characteristic vegetation composed primarily of sea oats (*Uniola paniculata*). The bay front is usually a mangrove swamp (*Rhizophora*). Numerous brackish water, drainage canals and fresh water ponds are present on the island.

The land snails of Siesta Key may be roughly divided into 3 groups: those found over the entire island, those restricted to areas inhabited by man, and those restricted to the margins of

the bay and the brackish water canals. In the accompanying list, these groups are indicated by the numbers 1, 2 and 3, respectively. A few snails are distributed over most of the island but are most common along the bay front. These are indicated by the number 4. One species (5) was found only in dune vegetation on the south tip of the Key. The greatest numbers of individuals and of species were found just outside of the most landward extensions of the mangrove swamps. Of the 3 species of snails restricted to inhabited areas, two are introduced and the third, the slug *Veronicella floridana* (Leidy), seems to prefer a diet of cultivated plants according to local residents.

The following list details all the species of land mollusks that were found on Siesta Key. The numbers indicate the habitat as previously discussed and the letters indicate the relative abundance of each species (V = very common, C = common, O = occasional, and R = rare).

- 1 C *Euglandina rosea* (Férussac)
- 3 C *Gastrocopta contracta* form *peninsularis* Pilsbry
- 3 V *G. pellucida hordeacella* (Pilsbry)
- 3 C *G. pentodon* (Say)
- 3 V *G. rupicola* (Say)
- 3 O *Guppya gundlachi* (Pfeiffer)
- 4 C *Hawaiiia minuscula* (Binney)
- 3 O *Helicina* (*Oligyra*) *orbiculata* (Say)
- 3 R *Microceramus floridanus* (Pilsbry)
- 2 O *Opeas pumilum* (Pfeiffer)
- 1 V *Polygyra cereolus* (Mühlfeld), including form *carpenteriana* (Bland)
- 3 C *P. pustula* (Férussac)
- 1 O *P. uvulifera* (Shuttleworth)
- 1 V *P. uvulifera striata* (Pilsbry)
- 3 R *Praticolella jejuna* (Say)
- 3 O *Pupoides modicus* (Gould)
- 3 O *Retinella dalliana* ("Simpson" Pilsbry)
- 4 O *R. indentata paucilirata* (Morelet)
- 3 O *Strobilops texasiana floridana* (Pilsbry)
- 2 C *Subulina octona* (Bruguière)
- 5 O *Succinea luteola floridana* (Pilsbry)
- 3 C *Thysanophora plagioptycha* (Shuttleworth)
- 3 C *Truncatella bilabiata* (Pfeiffer)
- 2 O *Veronicella floridana* (Leidy)
- 4 C *Zonitoides arboreus* (Say)

During this study, 20 stations in various localities and habitats were examined. Eight of these yielded only the most common land snails (symbol V in the list). At one station, no snails were found. With the exception of this single station, *Polygyra cereolus* was invariably present and apparently is the most common snail in this area.

I would like to thank Dr. William H. Heard of Florida State University for his valuable aid in the preparation of manuscript of this paper and also Dr. Joseph Vagvolgyi of the Florida State Museum for his kind assistance in the identification of several of the above species.

THE GENUS *AMIMOPINA* IREDALE, 1933

By DONALD F. McMICHAEL

Curator of Mollusca, The Australian Museum, Sydney

In a recent paper, Solem (1964) has given an invaluable account of the anatomy of the Australian land snail, *Amimopina macleayi* (Brazier) which clearly demonstrates that it is a member of the family Enidae.

In dealing with the nomenclature of the species, Solem discusses at length the generic name which has been used for it, *Amimopina*, and puts forward the case that, although the name was first proposed by Iredale (1933) and has been subsequently used in lists by a number of workers, it was not properly introduced by Iredale in 1933, according to the international code of zoological nomenclature, and therefore should be regarded as a *nomen nudum*. As a consequence of this, Solem introduced the genus as new in his paper.

While I agree with Solem that many Iredalean names are inadequately proposed according to the international code and possibly some of them will have to be regarded as *nomina nuda*, and while I deplore the generally vague manner in which many of these names were introduced, I feel that it is unfortunate that Solem should have chosen the name *Amimopina* for an example, especially as the facts are not quite as set out in his paper.

Solem states: "After mentioning a referral of *Bulimus macleayi* to *Papuina* (Camaenidae) that he considered incorrect, Iredale (1933, p. 42) states 'It may be noted that Kobelt (Conch. Cab., ed. Kuster (sic), Bd. i, Abth. 13, ante Sept., 1901) referred the species *macleayi* to *Bothriembryon* (Bulimulidae), a worse selec-

tion than *Papuina*, so that the new generic name *Amimopina* is proposed, the Australian *B. (ulimus) beddomei* Brazier being the type.' Iredale did not (i) have 'a statement that purports to give characters differentiating the taxon,' (ii) give 'a definite bibliographic reference to such a statement,' and (iii) no generic name had ever been proposed for *Bulimus beddomei*, so he was not proposing a substitute name."

However, if reference is made to Iredale (1933, p. 42) we find that the full text reads as follows:

"... the generic name *Rachispeculum* is introduced, the type being *Bulimus bidwilli* Cox, that specific name now being revived. The species bears so little resemblance to typical *Papuina* that it need scarcely be differentiated, but it may be noted that it is more elongate, with an entirely different mouth and quite rounded whorls. Almost as peculiar a reference to *Papuina* is the very thin, unicolor brown shell with rounded whorls like the preceding, which was described from Yule Island, New Guinea, as *Bulimus macleayi* by Brazier (Proc. Linn. Soc. N.S.W., i, 1876, p. 108) who reported it as being found in the dry season in crevices of coral rock. According to all other collectors, *Papuina* is essentially a tree-living group, a feature stressed by Hedley in connection with *P. folicola* above noted. Brazier later named an Australian shell *B. beddomei*, (Proc. Linn. Soc. N.S.W., i, 1876, p. 127, nom. nud.; iv, 1880, p. 394, May: Torres St.) but soon discarded it as equivalent to the New Guinea *macleayi*. There are differences however, and a third form lives near Port Essington." Then follows the paragraph quoted by Solem.

Now the above is very much more than "mention of a referral of *Bulimus macleayi* to *Papuina* that he considered incorrect." In fact the characters of the type species are described in a comparative manner with those of "typical *Papuina*" which is previously defined by reference to its type species and literature dealing with the group, and even ecological contrasts are drawn. Iredale might well have written:

Amimopina gen. nov. Type species: *Bulimus macleayi* Brazier. Diagnosis: Differs from typical *Papuina* Martens, 1860 (type species: *lituus* Lesson) in that the shells are very thin, unicolor brown, with rounded whorls (like those of *Bulimus bidwilli* Cox). The type species, from Yule Island, New Guinea, lives in coral rock crevices during the dry season (fide Brazier) and

therefore differs from *Papuina* s.l. which is arboreal. The genus includes two species, *B. macleayi*, and *B. beddomei* (from Torres Straits), while a third undescribed species lives at Port Essington." Such a presentation no doubt would have been perfectly acceptable. The fact that Iredale did not set out the new genus in the above manner is beside the point. All the pertinent information is given, and in my opinion, there can be no doubt that the new generic name was "accompanied by a statement that purports to give characters differentiating the taxon" and thus is available and validly introduced.

I shall, therefore, continue to regard Iredale as the author of the genus *Amimopina*, and of any other names introduced with similar detail.

REFERENCES

- Iredale, T. 1933. Systematic notes on Australian land snails. Rec. Aust. Mus. 19: 37-59.
Solem, A. 1964. *Amimopina*, An Australian enid land snail. Veliger 6: 115-120.

LYMNAEA (PSEUDOSUCCINEA) COLUMELLA FROM VENEZUELA, AND NOTES ON DISTRIBUTION OF PSEUDOSUCCINEA

BY EMILE A. MALEK¹ AND P. CHROSCIECHOWSKI²

In a study of the lymnaeid snails of the Gulf States and regions southward, collections were made in the southern United States, and in Venezuela; one collection was received from Costa Rica and others had been examined at the Museum of Zoology, University of Michigan. The lymnaeid collected in Venezuela was identified as *Lymnaea (Pseudosuccinea) columella* Say. A species of the subgenus *Pseudosuccinea* has not previously been reported from northern South America. The only other lymnaeid previously known to occur in Venezuela is the amphibious *Lymnaea (Fossaria) cubensis* Pfeiffer, 1839, whose type locality is Cuba, and whose general distribution can be described as the area along the Gulf of Mexico, and the Caribbean.

The snails from Venezuela were half-grown juveniles, living in

¹ Department of Tropical Medicine and Public Health, Tulane Medical School, New Orleans. The study was supported by National Institutes of Health Grants AI-02898 and 5-K6-AI-18.

² Division of Ancylostomiasis and other Helminths, Maracay, Aragua, Venezuela.

an aqueduct near Maracay, State of Aragua, attached to the concrete lining at the water surface and to floating sticks and debris. The mantle was heavily pigmented, but in the laboratory most of the pigmentation was lost and the progeny were only lightly pigmented. The morphology of the shell and body of these specimens agree in the main with that of those collected elsewhere in North and Central America.

The shell, with a characteristic short spire and large body whorl, is thin, horn color, and shiny on the surface; the axial sculpture is coarse and the spiral sculpture fine and microscopic. The large, ovate aperture is expanded at its lower portion. The vergic sac is narrower than the preputium and about half its length. A sarcobelum is present on the preputium. The uterus is globular, the vagina short, the prostate cylindrical and narrow. In the radula, the central tooth is unicuspid, the laterals, tricuspid.

The type locality of *Lymnaea* (*Pseudosuccinea*) *columella* Say, 1817 is probably near Philadelphia, U.S.A. According to Baker (1928), its general distribution extends over the eastern and mid-western states, ranging from Nova Scotia westward to Minnesota, Kansas and Texas, and from Manitoba and Quebec southward to Texas, Louisiana, Mississippi and Florida. Synonymous species described from within this range are *Lymnaea columella* Say, 1817; *Pseudosuccinea columella* Baker, 1911; *Limnaea navicula* Valenciennes, 1833; *Lymnaea columellaris* C. B. Adams, 1839; *Lymnaeus macrostomum* C. B. Adams, 1842; *Limnaea acuminata* C. B. Adams, 1870.

There are also records of this subgenus from Mexico and Cuba (Aguayo, 1938). Apparently the snail has been introduced into California (Gregg, 1923), Oregon (Vanatta, 1915) and Europe (Hubendick, 1951). Van der Schalie (1948) believes that it has been introduced into Puerto Rico where he recorded it as being fairly common in San Anton Creek, about 6 kilometers east of Rio Piedras, and abundant in small streams near the University campus (at Rio Piedras). Ferguson and Richards (1963) also record it as common in Puerto Rico.

In South America, information about lymnaeid snails is on the whole scanty. *Lymnaea peregrina* Clessin, 1882, whose type locality is Taguara del Mundo Novo, Brazil, has been found to have shell and body characteristics identical with those of *L.* (*Pseudo-*

succinea) *columella* Say, 1817 (Meeuse and Hubert, 1949; Hubendick, 1951). Shells of *L. peregrina* and those of *L. (Pseudosuccinea) columella* from Louisiana, Mississippi, and Michigan were examined in this study and found to be identical, taking into consideration the individual variations usually encountered within populations. According to Hubendick (1951), the distribution of *Lymnaea (Pseudosuccinea) columella* (syn. *L. peregrina*) in South America is as follows: Villarica in Paraguay, Rio Chico in southern Argentina (identified as *L. andeana* Pilsbry), and Rio Camaguam in Rio Grande do Sul, Brazil. There have been no previous records from Venezuela, or from the central and northern parts of Brazil or from the Guianas. Shells collected from Moravia de Chirripo Turrialba in Costa Rica by Dr. Rodrigo Brenes, University of Costa Rica, were identified as *L. (Pseudosuccinea) columella* Say. This snail has also been reported from Honduras (Hubendick, 1951) and Nicaragua (Van der Schalie, 1948).

On the basis of present information, the general distribution of this snail can be described as the area along the Gulf of Mexico, the Caribbean, and South America as far south as Paraguay.

REFERENCES

- Aguayo, C. G. 1938. Los molluscos fluviatiles cubanos. Parte I. Generalidades. Parte II. Sistemática. Mem. Soc. Cubana Hist. Nat. 12: 203-242; 253-276.
- Baker, F. C. 1928. The freshwater Mollusca of Wisconsin. Part I. Gastropoda. Wisc. Acad. Sci., Arts & Letters, Monograph.
- Ferguson, F. F. and Richards, C. S. 1963. Fresh water molluscs of Puerto Rico and the U. S. Virgin Islands. Trans. Amer. Micros. Soc. 82: 391-395.
- Gregg, W. O. 1923. Introduced species of *Lymnaea* in southern California. Nautilus 37: 34.
- Hubendick, B. 1951. Recent Lymnaeidae. Their variation, morphology, taxonomy, nomenclature, and distribution. Kungl. Svenska Vetenskapsakademiens Handlingar Fjarde Serien. Band 3, No. 1.
- Meeuse, A. D. J. and Hubert, B. 1949. The mollusc fauna of glass houses in the Netherlands. Basteria 13: 1.
- Vanatta, E. G. 1915. *Lymnaea (Pseudosuccinea) columella* Say in Oregon. Nautilus 29: 60.
- Van der Schalie, H. 1948. The land and freshwater molluscs of Puerto Rico. Misc. Publ. Mus. Zool. Univ. Mich. no. 70, 128 pp.

APERTURAL LAMELLAE AS SUPPORTING STRUCTURES IN AUSTRALORBIS GLABRATUS

By C. S. RICHARDS

Department of Health, Education, and Welfare, Public Health Service,
National Institutes of Health, National Institute of Allergy and
Infectious Diseases, Laboratory of Parasitic Diseases, Bethesda,
Maryland 20014

Apertural lamellae occur in several species of planorbid mollusks including some of the intermediate hosts of *Schistosoma mansoni*. In *Australorbis glabratus* the presence of lamellae is commonly associated with a spontaneous tendency to crawl out of the water (Parense, 1957; Richards, 1963). McCullough (1958) found lamellae in appreciable numbers of *Biomphalaria pfeifferi gaudi* in Ghana, collected mainly during the dry season. The possibility that these structures may have survival value to the snails under adverse conditions such as drought or mollusciciding needs evaluation. Richards (1963) has suggested that the lamellae function primarily as supporting structures. The following studies were conducted to test this.

Methods

Snails tested included: Laboratory colonies of albino *A. glabratus* originally from Brazil, *Tropicorbis obstructus* from Puerto Rico and from Louisiana, U. S., and *Tropicorbis albicans* from Puerto Rico. Each snail was placed on a glass slide on a spring scale and the weight noted. By means of a second glass slide pressure was gradually exerted downward on the snail until it was crushed. The force required to crush was recorded to the nearest 5 gms. up to 100 gms.; to the nearest 10 gms. above 100 gms. Only living snails were used, in matched pairs; two snails (one with lamellae and one without) taken at the same time, of the same diameter, from the same population, from the same jar, reared on the same food. One group of *A. glabratus* (I) was reared in gallon jars, fed only Romaine lettuce, and the water changed only when it became foul. A second group (II) was reared in a different laboratory in larger aquaria, fed both lettuce and powdered prepared food, the water aerated and periodically recirculated. The *T. obstructus* and *T. albicans* tests included specimens from both jars and aquaria, but each matched pair tested was from a single container.

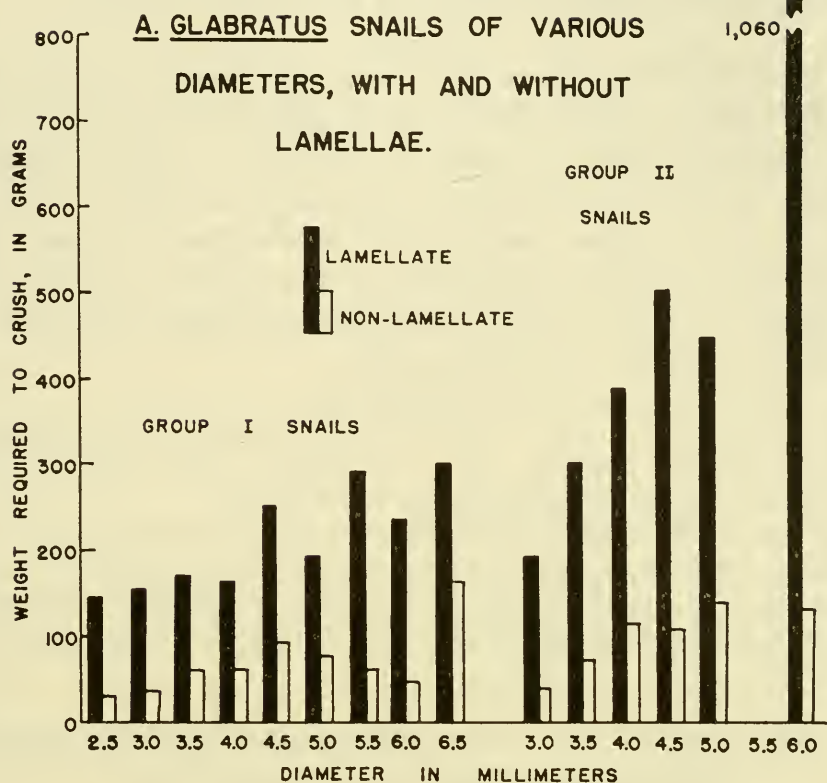
Results. In group I a total of 86 *A. glabratus* (43 matched pairs) ranging from 2.5 to 6.5 mm. in diameter was tested; in group II, 18 *A. glabratus* (9 matched pairs) 3.0 to 6.0 mm. in diameter. Results are shown in Table 1 and figure 1. In every matched pair of every size category in both groups the lamellate snail sustained considerable more force before being crushed than did the non-lamellate snail. In group I the average force needed to crush the lamellate snails was 175 gms.; the non-lamellate 55 gms.; the mean ratio 3.7:1. In group II the average force required to crush the lamellate snails was 470 gms.; the non-lamellate 105 gms.; the mean ratio 5.0:1.

In 54 (27 matched pairs) of the Louisiana strain of *T. obstructus*, 4.0 to 6.0 mm. diameter, the lamellate snails sustained an average force of 400 gms.; the non-lamellate 330 gms. The mean ratio, lamellate to non-lamellate (1.2:1), was not statistically significant, the standard error of the mean difference between the members of each matched pair being 0.3. In 26 (13 pairs) of the Puerto Rican *T. obstructus*, 4.5 to 6.0 mm. diameter, the lamellate snails sustained an average force of 355 gms.; the non-lamellate 270 gms. The mean ratio, lamellate to non-lamellate (1.3:1),

Table 1. SUMMARY OF CRUSHING EXPERIMENTS TO DETERMINE FORCE SUSTAINED BY
LAMELLATE AND NON-LAMELLATE PLANORBID MOLLUSKS

Snail species and source	Diameter in mm.	Number of specimens tested	Force sustained ratio, lamellate : non-lamellate	
			Range	Mean
<u><i>A. glabratus</i></u>				
Brazil (group I)	2.5-6.5	86	1.4:1-8.5:1	3.7:1
Brazil (group II)	3.0-6.0	18	2.2:1-8.2:1	5.0:1
<u><i>T. obstructus</i></u>				
Louisiana, U.S.	4.0-6.0	54	0.8:1-2.2:1	1.2:1
Puerto Rico	4.5-6.0	26	1.0:1-1.7:1	1.3:1
<u><i>T. albicans</i></u>				
Puerto Rico	4.0-5.0	24	1.2:1-2.0:1	1.43:1

FIG. I. AVERAGE WEIGHTS REQUIRED TO CRUSH



was not statistically significant, the standard error of the mean difference between the members of each pair being 0.18. In 24 (12 pairs) of the Puerto Rican *T. albicans*, 4.0 to 5.0 mm. diameter, the lamellate snails sustained an average force of 380 gms.; the non-lamellate 270 gms. The mean ratio, lamellate to non-lamellate (1.43:1), was barely significant statistically, the standard error of the mean difference between the members of each pair being 0.19 ($1/2P$ is less than 2.5%).

Discussion. Although snails of group II *A. glabratus* were generally stronger than those of group I, indicating more favorable growth conditions, the relationship between lamellae and resistance to crushing was comparable in both groups. The ability of the non-lamellate snails in the *Tropicorbis* species to sustain more force than in *A. glabratus* was to be expected, since lamella-formation usually occurs at maturity in the tropicorbids studied, while in *A. glabratus* it occurs in the relatively fragile immature snails (Richards, 1963). The results suggest that the lamellae have a survival value as supporting structures in *A. glabratus*.

under certain conditions, but that they are of little significance as supporting structures in the two *Tropicorbis* species.

SUMMARY

A total of 104 *A. glabratus* in matched pairs (lamellate and non-lamellate) were subjected to enough force to crush them. The lamellate snails sustained an average of approximately 4 times as much force as the non-lamellate. Tests with *T. obstructus* and *T. albicans* suggested that lamellae increased only slightly the strength of the shells in these species. Lamellae are considered to have survival value as supporting structures in *A. glabratus* under certain conditions.

REFERENCES

- McCullough, F. S., 1958. The internal lamellae in the shell of *Biomphalaria pfeifferi gaudi* (Ranson) from Ghana, West Africa. Jour. de Conchyliologie 97: 171-179.
Paraense, W. L., 1957. Apertural lamellae in *Australorbis glabratus*. Proc. Malacological Soc. London 32: 175-179.
Richards, C. S., 1963. Apertural lamellae, epiphragms, and aestivation of planorbid mollusks. Am. J. Trop. Med. and Hyg. 12: 254-263.

A NEW SPECIES OF CYAMIOMACTRA (PELECYPODA) FROM THE ROSS SEA, ANTARCTICA

By DAVID NICOL

Department of Geology, Southern Illinois University, Carbondale

Cyamiidae, *Cyamiomactra* Bernard, 1897

Type species (monotypy): *Cyamiomactra problematica* Bernard, 1897, pp. 310-311.

CYAMIOMACTRA ROBUSTA Nicol, new species. Pl. 6, figs. 1-3

Type repository: Division of Mollusks, U. S. National Museum. Holotype cat. no. 653063; paratypes cat. nos. 612811 and 612766.

Description: Shell thin, porcelaneous, somewhat chalky on the umbonal area; periostracum thin, glossy, light brown; ornamentation consists of fine concentric striae and prominent concentric ridges which may represent periodic growth cessation, number varying from 5 to 9 and commonly more closely spaced toward the ventral margin; a radial keel or rounded carina present on posterior quarter of the shell; prodissoconch not preserved; equivale; without a gape; valve outline subrectangular, anterior end rounded and somewhat pointed, posterior end subtruncate; length always greater than height; largest specimen is 9.7 mm. long, 8.7 mm. high, 6.9 mm. in convexity of both valves; smallest

specimen (holotype) is 8.8 mm. long, 6.6 mm. high, and 6.2 mm. for convexity of both valves; ratio of convexity to height for three specimens is 0.83; ratio of length to height for 3 specimens is 1.20; beaks small, orthogyrate; interior margins of shell smooth; concentric ridges on exterior of the shell correspond to concentric grooves on the interior of the shell; pallial line and adductor muscle scars not observable on these thin shells; ligament and hinge teeth typically cyamiid; lateral teeth absent; cardinal teeth 2 in the right valve and 3 in the left valve; central tooth 2 in left valve shaped like an inverted V, tooth 4a short and narrow and slopes antero-ventrally, tooth 4b is longer, narrow, and slopes postero-ventrally; teeth 3a and 3b in right valve are large, triangular, and bifid; ligament completely internal, narrow, sloping postero-ventrally, located in a narrow groove on the hinge plate behind the cardinal teeth in each valve; hinge plate narrow and rather short.

Comparisons: *Cyamiomactra robusta* appears to be most closely related to *C. laminifera* (Lamy), but it differs from the latter species by being more convex and by having well-developed concentric ridges on the exterior of the shell. *Cyamium exasperatum* Preston from the Falkland Islands superficially resembles *Cyamiomactra robusta*, but it is a much smaller shell and has only 2 cardinal teeth in the left valve.

Habitat: *Cyamiomactra robusta* was collected at two stations, one of which was 321 meters in depth and the other 640 meters in depth. The bottom temperature at the deeper station was -1.86° C. The type of bottom described from the shallower collecting station was coarse glacial marine till.

Geographic distribution: The holotype and one paratype with both valves came from $77^{\circ} 38' \text{ S.}$, $163^{\circ} 11' \text{ W.}$; Kainan Bay, Ross Sea. One right valve was collected at $77^{\circ} 26' \text{ S.}$, $169^{\circ} 30' \text{ E.}$; McMurdo Sound, Ross Sea.

Cyamiomactra robusta was collected only by the Deepfreeze I Expedition during January and February, 1956. It appears to be quite rare and may be endemic to the Ross Sea region. It may also be rather restricted in its distribution as to depth and kind of substrate upon which it lives.

Cyamiomactra robusta is one of the largest members of the Cyamiidae that the writer has seen. The largest of the 3 specimens is 9.7 mm. long. The other cyamiid species that attains at least this length is *Cyamiomactra laminifera* (Lamy) which also lives in the Antarctic region. Cyamiid species from warmer waters

in the southern hemisphere commonly attain no more than 5 mm. in length. This is another example of a family of pelecypods that has one or more of its largest species living in the coldest water. Two more cases of this phenomenon among species of Antarctic pelecypods will help to prove this point. The largest living species of limopsid is *Limopsis (Felicia) jousseaumi* (Mabille and Rochebrune) from the Antarctic region. However, other Antarctic species of limopsids are small. *Laternula elliptica* (King and Broderip), an Antarctic species, is the largest living laternulid with the possible exception of specimens of *Offadesma angasi* (Crosse and Fischer) from Stewart Island which may be as large. On the other hand, the largest pelecypods, like *Tridacna*, are confined to warm water. This trend among pelecypods to have the largest species of a family or a genus living in the coldest water seems to be so common that it could be considered an ecological or geographical rule.

Mr. W. J. Byas, museum specialist in the Division of Mollusks at the U. S. National Museum, skillfully opened and separated the 2 valves of the holotype so that the hinge area could be described and then later repaired the left valve of the holotype after it was broken by the writer.

Mr. David H. Massie of the U. S. Geological Survey made the photographs of *Cyamiomactra robusta*.

This short paper is a preliminary note on a study of Antarctic pelecypods which is being supported by a grant from the National Science Foundation (G-13335).

LITERATURE CITED

Bernard, F. 1897. Sur quelques coquilles de Lamellibranches de l'île Stewart. Bull. Mus. Hist. Nat. Paris, no. 7: 309-314.

AMERICAN MALACOLOGICAL UNION, INC.

By MARGARET C. TESKEY, Secretary

The 30th annual meeting of the American Malacological Union was held in New Orleans, July 21-24, 1964. One hundred registered guests enjoyed a most unusual program, minded the heat not at all and with a moonlight boat ride on the mighty Mississippi as the final feature, voted the 1964 meeting an unqualified success.

Dr. Dee Dundee and Dr. Harold Dundee planned and arranged for the 4 day convention while John Q. Burch of Los

Angeles as A.M.U. President presided over presentation of 26 scientific papers by as many authors, an instructive and well balanced program.

Other highlights were a tour of historic New Orleans and field trips which took the land shell collectors on a 100 mile bus tour of the bayou country while others dredged in Lake Pontchartrain from two boats loaned by the Louisiana Wildlife and Fish Commission. Another highly enjoyable feature was the annual dinner at Arnauds, one of the city's famed French restaurants; the hardy relished and the timid sampled "escargot," many for the first time.

These papers made up the scientific program: Freshwater mollusks of the Hudson Bay watershed, Arthur H. Clarke, Jr. Shell deformity of mollusks caused by *Hydractinia echinata*, Arthur S. Merrill. Behavior of unionid glochidia, William H. Heard and Sherman S. Hendrix. The foreign freshwater snails now established in Puerto Rico, Harold W. Harry. Who were The Sowerbys? Katherine V. W. Palmer. Fresh-water Mollusca from the early Tertiary of Patagonia, J. J. Parodiz. Geographic distribution of eastern American brackish water mollusks, J. P. E. Morrison. A phenomenon associated with sexual behavior in polygyrid snails, Walter C. Blinn. "Indo-Pacific Mollusca," R. Tucker Abbott. Molluscan magnetism, Lulu B. Siekman. Some highlights in the study of mollusks on the United States Gulf Coast, Gordon Gunter. Radulae of Ottawa River snails, Maryl Weatherburn. Cytotaxonomy of the genus *Oncomelania*, John B. Burch. The Coosa River and its shells, Herbert D. Athearn. *Tarebia granifera* and *Melanoides tuberculata* in Texas, Harold D. Murray.

Anatomical relationships in the Teredinidae, Ruth D. Turner. The evolution of Mesogastropoda, Donald R. Moore. Disc electrophoresis in the study of molluscan systematics, George M. Davis and Gene Lindsay. The chromosome cycle in the land snail *Catinella vermeta*, C. M. Patterson (read by Robert Wakefield). Cytological studies of opisthobranch mollusks, R. Natarajan. Notes on the sex of *Campeloma*, Henry van der Schalie. The mussel shoals of the Tennessee River revisited, David H. Stansbery. Cell and tissue culture of mollusks, Catalina Cuadros and John B. Burch. Gastropods in scientific research, Albert R. Mead (read by title). Stunting of *Oncomelania formosana* in culture, Henry van der Schalie and George Davis.

Over the past year new constitutions have been adopted by the A.M.U. and by the A.M.U., Pacific Division. The American Malacological Union has been incorporated as a scientific, non-profit organization. At the recent meeting, the following were elected to hold offices in 1964-65:

President, Juan J. Parodiz. Vice-president, Ralph W. Dexter. 2nd Vice-president, Edwin C. Allison. Secretary, Margaret C. Teskey. Treasurer, Jean M. Cate. Publications Editor, M. Karl Jacobson. Councillors-at-Large, William H. Heard, Leo G. Hertlein, Leslie Hubricht, Richard I. Johnson.

The 1965 annual meeting will be held at Wagner College on Staten Island, New York, July 20th through the 23rd.

NOTES AND NEWS

Increase in price of Nautilus. — Bare costs of printing, exclusive of postage, again are exceeding considerably the income from subscriptions. For this reason, beginning with volume 79 (July, 1965), but not including renewals for 1965, domestic subscriptions will be raised to \$4.25 a year, and foreign ones to \$4.75. The extra increase in foreign subscriptions is due largely to the postage on requested separate invoices.

OYSTER CHROMATOGRAM — *Crassostrea virginica* (Gm.) collected from the York River, Va., above the Fleet Weapons Pier at Yorktown, June 24, 1964, was used for chromatographic studies during an N.S.F. program (Grant GE-3798) at La Salle College. The specimen was preserved in the field in FAA. fixative.

The oyster was macerated and spotted on Whatman's No. 1 Filter Paper. The chromatographic solvent used was butanol : acetic acid : water (4:1:1). The solvent front was permitted to migrate 18 cm. The resulting chromatograms were sprayed with ninhydrin solution (50 ml. of 0.2% ninhydrin in methyl alcohol, plus 10 ml. glacial acetic acid, and 2 ml. 2-4-6 collidine) and submitted to a temperature of 110° C. for a period of 30 minutes.

Twenty-two pure amino-acids were prepared in a buffer of pH 3.7 (the pH of the macerated oyster) and the chromatographic procedure was repeated.

Rf values for each amino-acid and for each region of coloration in the oyster material were computed and compared. Tentative conclusions indicated the presence of L-cystine (Rf = .094), L-arginine (Rf = .166), glycine (aminoacetic acid) (Rf = .278),



All figures of holotype of *Cyamiomactra robusta* Nicol, 5x. U. S. N. M. cat. no. 653063. Fig. 1. right valve, exterior. Fig 2. right valve, interior. Fig. 3. left valve, interior.

and DL-alpha-alanine ($R_f = .360$). Comparable R_f values for these 4 amino-acids in pure form were: .094, .178, .266, and .361, respectively.

"Analytrol" charts were produced for each chromatogram. The tentative conclusions were confirmed by comparison of the location of peaks along the horizontal scale.

Light coloration throughout the chromatograms and an irregular trace recording indicate a strong probability of the presence of other amino-acids. — VERONICA M. BIERBAUM, Bethlehem, Pa.

LITTORINA ZICZAC (GMELIN) AND L. LINEOLATA ORBIGNY — Since Bequaert's 1943 monograph on "The Genus *Littorina* in the Western Atlantic" (Johnsonia, vol. 1, no. 7, see pp. 14-18), most workers have followed the suggestion that sexual dimorphism accounted for the extreme shell variability in *Littorina* (*Melarhaphe*) *ziczac* (Gmelin, 1791). That two species were involved was noted by Dr. J. P. E. Morrison (*in litt.*) on the basis of shell characters. Thanks to fresh material obtained in Grenada by Mrs. Ruth Ostheimer and Dr. Minerva Buerk, it is now known that males and females are present in two forms. The egg capsules of "*ziczac*" illustrated by Lebour (1945), Abbott (1954), J. B. Lewis (1960), and Marcus and Marcus (1963) strongly suggest, because of their differences, that all these authors have been working with a mixture of these two species.

True *ziczac* Gmelin is illustrated in Bequaert's monograph, pl. 5, figs. 1-4, and in "American Seashells" by Abbott on pl. 19, fig. e. It is characterized by its smoothish surface, by its fairly well-rounded whorls, light ash-gray color over which are rather distinct, usually evenly-spaced, axial, slanting, narrow flames or stripes of weak brown. The surface sculpture consists of numerous, microscopic incised spiral scratches, usually about 20 to 30 between sutures. The nuclear whorls are seldom eroded away.

L. lineolata Orbigny is illustrated by Bequaert on his pl. 5, figs. 5-10, and in "Caribbean Seashells" by Warmke and Abbott on pl. 9, fig. 1. It differs from *ziczac* in being usually smaller, more darkly colored, and in having only 5 to 9 spiral incised lines between sutures, in having flat-sided whorls and a keeled base, and in sometimes being spirally corded. The apex is usually eroded away.

The ranges of these two species appear to be about the same,

although in Bermuda *lineolata* is rare, while in Texas *ziczac* is absent or rare. They live in approximately the same tidal zone, but further observations are needed. An examination of Dr. Robert Robertson's photographs (*in litt.*) of the holotype of *Phasianella lineata* Lamarck, 1822 [not *Buccinum lineatum* Gmelin, 1791, which is *Littorina scabra* (Linné, 1758)], supports Bequaert's statement that Lamarck's species is *tessellata* Philippi, 1847.

Among the obvious synonyms of *ziczac* Gmelin are *debilis* Philippi, 1846, *d'orbignyana* Philippi, 1847, and *dispar* Montagu, 1815. Synonyms of *lineolata* Orbigny, 1842, are *carinata* Orbigny, 1842 (non Sowerby, 1819), *crassior* Philippi, 1847, and *jamaicensis* C. B. Adams, 1850. — R. TUCKER ABBOTT.

ON *LYMNAEA AURICULARIA* IN COLORADO. — Henderson (1912, *Nautilus* 26:84 and 1918, *ibid.* 32:71) reported the Palearctic pond snail *Lymnaea auricularia* (L.) from Colorado Springs (El Paso Co.) and Dotson Reservoir, near Fowler (Otero Co.), Colorado. Recent collections have it from Varsity Pond in Boulder (Boulder Co.) and City Park Lake in Fort Collins (Larimer Co.), extending the range in Colorado northward along the east face of the Rocky Mountains. The location of 3 of the 4 Colorado colonies in city park lakes would indicate that each probably results from a separate introduction. — CLARENCE J. MCCOY, JR.

GLAUCONOME RUGOSA, 1842. — Both date and author are given incorrectly in Sherborn, 1902, *Index Animal.*: 5676. *Glaucanome rugosus* (sic) was figured by Hanley, 1842, [Lamarck's] *The species of shells*: pl. 2, fig. 31, and named in the accompanying "List of illustrations" [for pls. 1 to 3]. Apparently this small, hand-colored lithograph was copied (as a mirror image) in Hanley, "early part of 1843" (Preface: v; probably 1856), *Ill. & desc. cat. rec. bivalve shells* (1842-1856): pl. 10, fig. 24. Incidentally, bound in the A. N. S. P. copy of the evidently rare Hanley, 1842, are "A list of the species delineated in the supplementary plates," etc. (only pages 1 to 8) and (at the end) the "Systematic list of the shells figured in this work," etc. (pages 1 to 8). Thus the former (or both?) of these appears to be "their explanatory text" (1856, *loc. cit.*) for plates 9 to 13 of Hanley, 1842-1856, and the wording seems identical with those bound in the A. N. S. P. copy of this last. [Page 9 of the list suppl. pls. is signa-

ture-marked "APP." etc.] This apparently means that all the names of species on pls. 9-13 were vested (made valid) at least "early" in 1843, and are prior to any bivalve in Reeve's "Conchologia Iconica." Involved names in *Corbula* are: *C. crassa*, *C. fasciata*, *C. nimbosa* and *C. trigona*¹ (not Roemer, 1836). — H. BURRINGTON BAKER.

ELLIPTIO COMPLANATA WHEATLEY. — Apparently *Unio wheatleyi* Lea, 1858, Proc. Acad. Nat. Sci. Philadelphia 9: 85, is neither a homonym or a "nomen oblitum," although Lea, 1862, J. A.N.S.P. 5: 54, pl. 1, fig. 209; Obs. 8: 58, substituted *U. catawbensis* for it. Both names seem to be prior to *U. rostrum* Lea, 1862, Proc. cit. 13: 391, which was used by Simpson, 1914: 660, for a species. — H. B. B.

E. (UNIOMERUS) TETRALASMUS SAYANA. — Is an incomplete description, despite the incorrect reference to an unpublished plate, enough to validate *Unio sayanus* Conrad, 1838, Monogr. no. 11: 102, "pl. 55, fig. 2?" If so, Conrad, 1840, Monogr. no. 12: 103, pl. 56, lower 3 figs., was right, when he included, as a junior synonym, *U. sayi* Ward in Tappan, 1839, Amer. J. Sci. 35: 268, pl. 3, fig. 1. In any case, this is only a question of spelling.—H. B. B.

GALATEA (DONACIDAE). — According to article 56 (a) of the 1961 "code," *Galatea* Brugière, 1797, Encycl. Méth. (Tabl. Vers): pl. 250, is not a junior homonym. It originally included only one (unnamed) species, *Venus paradoxa* Born, 1780. However, because its emendation, *Galathea* Lamarck, 1804, Ann. Mus. Hist. Nat. Paris 5: 431, is preoccupied, it often has been replaced by *Egeria* Roissy, 1805. Evidently, *Galatea* must be restored as the lawful name for this estuarine group of west Africa. — H. B. B.

OXYCHEILUS (SUBULININAE?). — Also because of a difference of one letter, *Oxycheilus* Albers, 1850, Die Heliceen: 174, is not a homonym of *Oxychilus* Fitzinger, 1833 (Zonitinae) or *Oxycheila* Dejean (1825). As already has been indicated, 1963, Proc. Acad. Nat. Sci. Philadelphia 115: 216, *Synapterpes* Pilsbry, 1896, Naut. 10: 46, must be replaced by *Oxycheilus*, of which *O. hanleyi* (Pfeiffer in Philippi) is the type species, for this Brazilian

¹ According to Lamy, 1941, *C. assiniensis* Chaper, 1885, is a usable synonym.

group. Unfortunately, a supposed homonym seldom becomes a "nomen oblitum," because it is repeated continuously as a senior synonym. — H. B. B.

CORBULA LIMATULA, 1846. — Has anyone subsequently collected *C. limatula* Conrad, June, or earlier, 1846, Proc. Acad. Nat. Sci. Philadelphia 3: 25, pl. 1, fig. 2, dredged off the west coast of Florida? Apparently, if Edouard Lamy, 1941, J. de Conch. 84: 228, had not noticed the description, it now would be a "nomen oblitum." The type specimen is in the A.N.S.P. (no. 50909a); it is about the size of Conrad's fig. and measures: right valve 8.2 x 6.3 mm., left (smoother and still stuck in place) 7.2 x 4.8; diam. 4.6 mm. Under the present "code," the name should continue valid until 2014. — H. B. B.

ABSTRACT REPORTS ON OCEANOGRAPHY. — Stepped-up emphasis on research in aquatic biology, particularly oceanographic studies, is evidenced by a 145% increase in numbers of these papers abstracted by Biological Abstracts (BA) since 1959. Abstracts cross referenced to Oceanography from numerous other inter-related areas of biology add to this total by another 70-100%. Both broad and specific coverage of life science papers relating to Oceanography is provided in Biological Abstracts. Searches in this field are facilitated through use of appropriate index words in *B.A.S.I.C.* and through a check of abstracts listed under Oceanography in the Cross Index. — RELEASE.

ADELOPOMA COSTARICENSE Bartsch and Morrison, 1942, not an inhabitant of the United States—Several years ago, Haas (1947, Nautilus 61: 33-34) reported that a single specimen, apparently referable to this species, had been collected alive at a light trap in Charleston, South Carolina. During a current review of *Adelopoma*, the specimen (CNHM 24510) was re-examined and found to be misidentified. It is the Mariana Island *Palaina taeniolata taeniolata* Quadras and Moellendorff, 1894, and probably is a mislabeled shell. CNHM 24925 contains a long series of *P. taeniolata* collected by H. S. Dybas in 1945 about 1 mile from Yigo, Guam Id., Mariana Islands. The supposed *Adelopoma* cannot be distinguished from members of this set. A Division of Insects label reading "Charleston, South Carolina, April 12, 1945, R. L. Wenzel collector" is still with the shell. Both Dr. Wenzel and Mr.

Dybas (entomologists at Chicago Natural History Museum) had recently returned from wartime duties and their collections were being sorted by Division of Insect personnel aided by college students. The label with the "*Adelopoma*" can be identified as having been written by one of the college students. These facts present the strong probability that mislabeling is involved rather than an introduction. Of all the diplommatinids, the Micronesian *Palaina* are most closely allied in shell form and sculpture to the Neotropical *Adelopoma*, the former differing only in greater upwards expansion of the parietal-palatal lip. Controversy still exists as to whether *Adelopoma* is native to Central and South America, or whether it has been introduced from the Old World. Review of all known *Adelopoma* by one of us (Solem) indicated a pattern of variation in *Adelopoma* that is not exactly duplicated by any Old World species group, although no adequate generic distinctions from *Palaina* could be recognized. Confusion of *Adelopoma* and *Palaina* is quite easy. ALAN SOLEM and FRITZ HAAS, Chicago Natural History Museum, Chicago, Illinois.

TYPE LOCALITY FOR *PARAVITREA SMITHI*—*Paravitrea smithi* (Walker) was described from two specimens collected by Herbert H. Smith from Sand Mountain near Pisgah, Jackson Co., Alabama.

I collected at several localities on Sand Mountain near Pisgah without finding it. I then made a list of all the species which Walker (1928, Terr. Moll. Ala., Univ. Mich. Mus. Zool. Misc. Publ. no. 18.) recorded from near Pisgah. There were 20 species, several of which were calciphiles. This indicated that Smith's collections were made on the lower side of the mountain, rather than on the summit. After examining topographic maps of the vicinity, I decided that the most likely place was below Sublett Gap, about 4 miles west of Pisgah. Here an old road went down the side of the mountain to where at one time there had been a ferry on the Tennessee River. I visited this place in early June, 1964 and collected two specimens of *Paravitrea smithi*, together with most of the species which Walker reported from Pisgah. I believe this is the place where Smith collected his specimens.

One specimen was mature with 5 whorls, the other was an immature shell of 3 whorls. There were no teeth in either specimen. The animals were white.—LESLIE HUBRICHT.

STENOTREMA MAGNIFUMOSUM IN THE CUMBERLAND MOUNTAINS—*Stenotrema magnifumosum* (Pilsbry) was found living in the canyon below Fall Creek Falls, Van Buren County, Tennessee. During the Pleistocene, species of higher altitudes in the southern Appalachians were able to move down to lower elevations and extend their ranges. In some favorable localities they were able to survive to the present.—LESLIE HUBRICHT.

RICHARD WINSLOW FOSTER, of the Museum of Comparative Zoölogy at Harvard University, died suddenly September 3, 1964, in Rome, Italy, of asthma, after an apparently successful operation for appendicitis. He was 44 years of age. "Dick" will be missed greatly by all his many friends, and colleagues in the collection and study of mollusks, and our sympathies are extended to his wife.

PUBLICATIONS RECEIVED

- Mathews, L. Harrison & Maxwell Knight. 1963. The senses of animals. 240 pp., 40 figs. & frontispiece. Philosophical Library, 15 East 40th St., New York 16, N. Y. \$7.50.—Notes on eyes and touch-receptors of mollusks are included.
- Nicol, David. 1962. The biotic development of some Niagaran reefs—An example of an ecological succession of sere. *J. of Paleont.* 36: 172-176, 1 fig.
- Paraense, W. Lobato. 1963. The nomenclature of Brazilian planorbids, 3. "*Australorbis stramineus*" (Dunker, 1848). *Rev. Brasil. Biol.* 23: 1-7.
- & Lygia R. Corrêa. 1963. Variation in susceptibility of populations of *Australorbis glabratus* to a strain of *Schistosoma mansoni*. *Rev. Inst. Med. trop. Sao Paulo* 5: 15-22, 1 fig.
- & do. 1963. Susceptibility of *Australorbis teganophilus* to infection with *Schistosoma mansoni*. *Rev. cit.*: 23-29.
- & Newton Deslandes. 1962. "*Australorbis intermedius*" sp. n. from Brazil (Pulmonata, Planorbidae). *Rev. Brasil. Biol.* 22: 343-350, 6 figs.
- Pilson, M. E. Q. & P. B. Taylor. 1961. Hole drilling by *Octopus*. *Science* 134: 1366-1368, 1 fig.
- Rezende, H. E. Barboza & P. D. Lanzieri. 1963. Uma nova especie do genero *Protoglyptus* Pilsbry, 1897, do Brasil. *Mem. Inst. Oswaldo Cruz* 61: 111-126, 38 figs. — Shell and anatomy.
- Riedel, Adolf. 1963. Zwei neue Zonitidae (Gastropoda) von Südostbulgarien. *Ann. Zoo. Polska Akad. Nauk* 20: 473-485, 18 figs. — New species are added to *Oxychilus* & *Carpatica*.

- 1963. Ein rezenter *Hawaiiia*-Fund aus Afghamistan und ein fossiler aus dem Kaukasus (Gastropoda, Zonitidae). Ann. cit. 21: 33-41, 14 figs. — 2 new species are added.
- 1963. Fossile Zonitidae (Gastropoda) aus dem Kaukasus. Ann. cit. 21: 273-287, 18 figs. — New species are proposed in *Oxychilus*, *Vitrea* & *Vitrinoxychilus* ("gen. n." but not described).
- La Rocque, Aurèle. 1960. Quantitative methods in the study of non-marine Pleistocene Mollusca. Intern. Geol. Cong. 21 (4): 134-141, 1 fig.
- Schalie, Henry van der. 1963. People and their snail-borne diseases. Mich. Quart. Rev. 2: 106-114, 1 fig. & 1 map.
- & Lowell L. Getz. 1962. Reproductive isolation in the snails, *Pomatiopsis lapidaria* and *P. cincinnatiensis*. Amer. Midl. Nat. 68: 189-191, 1 fig.
- & Getz. 1962. Distribution and natural history of the snail *Pomatiopsis cincinnatiensis* (Lea). Vol. cit.: 203-231, 13 figs.
- & Getz. 1962. Morphology and development of the sex organs in the snail, *Pomatiopsis cincinnatiensis* (Lea). Trans. Amer. Micr. Soc. 81: 332-340, incl. pls. 1-5.
- & Getz. 1963. Comparison of temperature and moisture responses of the snail genera *Pomatiopsis* and *Oncomelania*. Ecology 44: 73-83, 12 figs.
- & Guy Colwin Robson. 1963. Bivalve. Encycl. Britt.: 8 pp., 18 figs.
- Schalie, Henry and Annette van der. 1963. The distribution, ecology, and life history of the mussel, *Actinonias ellipsiformis* (Conrad) in Michigan. Oc. Papers Mus. Zoo. Univ. Mich. no. 633: 17 pp., incl. 3 pls.
- Sinclair, Ralph M. 1963. Effects of an introduced clam (*Corbicula*) on water quality in the Tennessee River valley. 12 pp. & 1 pl.
- Solem, Alan. 1960. Notes on South American non-marine Mollusca 1-3. Ann. Mus. Civ. Stor. Nat. Genova 71: 416-432, pls. 24 & 25. — New species and subsp. are proposed in *Eudolichotis*, *Choanopoma* & *Tudora*.
- 1959. Notes on Mexican mollusks, 2. Oc. Papers Mus. Zoo. Univ. Mich. no. 611: 1-15, incl. pls. 1 & 2. — A new species is added to *Polygyra*.
- Thompson, Fred G. 1963. Systematic notes on the land snails of the genus *Tomocyclus* (Cyclophoridae). Breviora M. C. Z. no. 181: 11 pp., incl. 1 fig. & 1 pl. — A new species is added.
- 1963. New land snails from El Salvador. Proc. Biol. Soc. Washington 76: 19-31, incl. figs. 1-2 & pls. 1-2. — New species are proposed in *Amphicyclotus*, *Streptostyla*, *Eucalodium* & *Lysinoe*.
- Turner, Ruth D. 1961. The genus *Lignopholas* Turner (Phola-

- didae). Mit. Zoo. Mus. Berlin 37: 287-295, incl. pls. 1-4.
- Tuthill, Samuel J. 1961. A molluscan fauna and late Pleistocene climate in southeastern North Dakota. Proc. N. D. Acad. Sci. 15: 19-26, 3 figs.
- Tweedie, M. W. F. 1961. On certain Mollusca of the Malayan limestone hills. Bul. Raffles Mus., Singapore no. 26: 49-65, fig. 1, pls. 15-16.
- Uminski, Tomasz. 1962. Revision of the Palearctic forms of the genus *Discus* Fitzinger, 1833 (Endodontidae). Ann. Zoo. Polska Akad. Nauk 20: 299-333, incl. 1 fig., 3 maps, 5 tables and pls. 3-4.
- 1962. Taxonomy of *Anguispira* (?) *marmorensis* (H. B. Baker, 1932) with notes on the taxonomy of the genera *Anguispira* Morse and *Discus* Fitzinger (Endodontidae). Ann. cit. 21: 81-91, 19 figs. & 1 table.
- Verdcourt, Bernard. 1959. Scorpion shells. E. Afr. Nat. Hist. Soc. J. 23: 1 p.
- 1960. East African slugs of the family Urocyclidae, pt. 2. J. cit.: 233-240, figs. 5-8. — A species is added to *Urocyclus*.
- 1960. Some further records of Mollusca from N. Kenya, Ethiopia, Somaliland and Arabia, mostly from arid areas. Rev. Zoo. Bot. Afric. 61: 221-265, 9 figs. — Inland mollusks with some anatomy.
- & R. Polhill. 1961. East African slugs of the family Urocyclidae, (parts 3 & 4). J. E. Africa Nat. Hist. Soc., special suppl. 7: 36 pp., 41 figs. — New species and subspp. are added to *Trichotoxon*.
- 1961. Notes on the snails of north-east Tanganyika. Coryndon Mem. Mus. Oc. Papers no. 8: 23 pp., 18 figs. — Streptaxidae, with anatomy.
- 1961? The cowries of the east African coasts. Supplement 3. J. E. Afr. Nat. Hist. Soc. 23: 281-285, & 3 figs. (as 2 pls.).
- 1962. Report on a collection of East African slugs (Urocyclidae). J. cit. 24: 29-36, & 14 figs. (as 5 pls.).
- Zárate López, Adolfo Ortiz de. 1962. Una especie nueva de *Helicella* (*Helicella* (*Xeroplexa*) *cobosi*). Arch. Inst. Acclimatacion (Almeria) 11: 41-43, pl. 1.
- 1962. Observaciones anatómicas y posición sistemática de varios helicidos españoles. 5, Género *Oestophara* Hesse, 1907. Bol. R. Soc. Esp. Hist. Nat. (B) 60: 81-104, 14 figs. — A new species is added.
- SHELLS. Photographed for "Life" by Nina Leen. 1964. Life 57 (2): 46-54, 12 large figs., mainly colored. This contains an interesting account of the shell-collecting experiences of George and Mary Kline, Shunpike Road, Box 271, Madison, N. J., in the oceans around Ceylon and the Pacific islands.

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NEW SPECIES OF VITRINELLIDAE FROM GULF OF MEXICO AND ADJACENT WATERS¹

By DONALD R. MOORE

Institute of Marine Science, University of Miami

Abstract

The systematics of the families Vitrinellidae and Tornidae are briefly reviewed and reasons given for maintaining the two families as separate entities. Three new species of Vitrinellidae from the Gulf of Mexico are described, *Macromphalina floridana*, *Vitrinella texana*, and *Solariorbis semipunctus*.

* * * * *

The family Vitrinellidae is fairly large with about 220 described recent species from the Western Hemisphere, and with probably as many or more from the Indo-Pacific region. The western Atlantic species number over 60, but many are poorly known or have not been seen since their description. The writer, while working on the vitrinellid fauna of South Florida and the Gulf of Mexico, found 3 species that had evidently been missed by previous workers on these minute mollusks. They are described below along with a brief discussion of the systematics of the family.

Early workers placed vitrinellids in *Rotella*, *Umbonium*, or other small trochid genera. Fischer (1857) described several new species as *Adeorbis-Tornus*, while many authors placed species in *Cyclostrema*. Katherine Bush (1897) was the first to point out that *Vitrinella* and its allies should be placed in a separate family, but she, unfortunately, did not have a clear understanding of the affinities of the group. She clearly thought that they were related to the Trochidae, and included a number of genera which are certainly not vitrinellids. It was Pilsbry and McGinty (1945) who first showed figures of living vitrinellids, and Pilsbry later (1953) placed the family in the Rissoacea.

Abbott (1950) showed that *Cyclostrema* is a genus closely

¹ Contribution No. 580 from The Marine Laboratory, Institute of Marine Science, University of Miami.

allied to *Liotia*, and placed the genus in the Liotiidae. Thus *Cyclostrema* is shown to be quite different from the vitrinellids, and the family name Cyclostrematidae is synonymous with Liotiidae. Many of the species formerly grouped under Cyclostrematidae should go into Skeneidae, or if mesogastropods, into some other family. Malacologists have often equated the Vitrinellidae with the Adeorbidae-Tornidae, and the most recent such classification is that of Taylor and Sohl (1962). They state that the name Vitrinellidae should be used in preference to Tornidae on the grounds that the former name has been used more often. However, nearly everyone has ignored the anatomical work of Woodward (1899) on *Tornus subcarinatus* (Montagu), the type species of *Tornus*, and the work of Fretter (1956) on a vitrinellid, *Circulus striatus* (Philippi). In addition, Pilsbry and McGinty (1945) gave information on the external morphology of vitrinellids, including *Vitrinella helicoidea* C. B. Adams, the type species of *Vitrinella*. Moore (1962) provided a more precise illustration and description of the external morphology of the vitrinellid, *Parviturboides interruptus* (C. B. Adams).

When the vitrinellids are compared with *Tornus subcarinatus*, the following important differences are noted: 1.) The vitrinellids have a circular, multispiral operculum; *Tornus* has a paucispiral oval operculum. 2.) The vitrinellids have a penis in the male; this organ is lacking in *Tornus*. 3.) The gill is deep in the mantle cavity of vitrinellids; it extends well out of the right side of the aperture in *Tornus* and may even curve around the margin of the shell. Fretter (1956) cites further important differences in the internal anatomy. There are similarities in the appearance of the shell, in features of the radula, and both possess a pair of pallial tentacles on the right side of the mantle. However, while relationship is apparent, the differences are too great to put *Tornus* in the same family with the vitrinellids.

In view of the above observations, the writer feels that attempts to equate the Vitrinellidae with the Tornidae are based on misconceptions, and that both families should take their place in the superfamily Rissoacea.

Acknowledgments. All the specimens but one were collected by various people who turned their material over to the writer. Thanks are extended to the following persons for their cooperation and interest: Mrs. Winnie Rice, Mrs. Edna Marcott, Dan

Steger, and Barry and Buena Valentine. The specimen of *Macromphalina floridana* from Soldier Key was collected as part of a qualitative sample in the sea grass *Thalassia testudinum* under National Science Foundation grant no. G-14521. The study was completed under National Science Foundation grant no. GP-2455.

MACROMPHALINA FLORIDANA, sp. nov.

Pl. 7, figs. 1-3

Description. The shell is depressed, with a tilted, slightly projecting protoconch. The umbilicus is widely open, periphery strongly carinate, and the aperture strongly oblique.

The protoconch consists of approximately $11\frac{1}{2}$ smooth glassy whorls. It terminates with a barely discernible varix, and the sculpture of the teleoconch begins immediately after. The teleoconch consists of nearly two whorls in the holotype, and is covered, both top and bottom, with sculpture of narrow, recurved radial ribs. Between the ribs there is a microsculpture of close set spiral threads. The radial ribs above the periphery are opisthocline, while those below are prosocline. They are not continuous, however, for the ribs are slightly more numerous on the upper half of the shell. There were 46 counted on the dorsal half, 34 on the lower half of the body whorl of the holotype.

The aperture is oblique, and viewed from below, is broadly ovate. The upper part of the peristome overhangs the aperture considerably. The peristome is continuous, and in the holotype, is slightly separated from the preceding whorl. The peristome is closely appressed to the preceding whorl in the paratype from Soldier Key, but this specimen is evidently not quite mature. The umbilicus is widely open, and the sculpture continues on the inner surface up to the preceding whorl.

Material. Holotype. Madeira Beach at 150 Avenue, St. Petersburg, Florida, collected by Mrs. Edna Marcott during the winter of 1959; diameter, 3.1 mm., altitude, 1.5 mm. Deposited in the Division of Mollusks, U. S. National Museum, no. 636310. Paratypes. 1 specimen from the east side of Soldier Key, Biscayne Bay, Florida, in a depth of about 1 meter, November 2, 1961, collected by D. R. Moore; diameter, 1.9 mm., altitude, 1.0 mm., UMML no. 30:2773. 1 specimen from Madeira Beach at 150 Avenue, St. Petersburg, Florida, collector, D. Steger; diameter, 1.0 mm., altitude, 0.5 mm. Academy of Natural Sciences of Philadelphia no. 295621. This specimen was considerably larger, but most of the

second adult whorl has been broken away.

Name derived from Florida, the state where all the material was collected.

Remarks. *Macromphalina floridana* is strongly carinate; the other two West Indian species have a rounded periphery. *M. caro* (Dall) is much more elevated, but *M. palmalitoris* Pilsbry and McGinty is similar to *M. floridana* in size and shape. There are other differences between *M. floridana* and *M. palmalitoris*, however, for *M. floridana* has a tilted protoconch and discontinuous axial ribs, while *M. palmalitoris* has an erect protoconch and continuous axial ribs. The axial sculpture of *M. floridana* is also much stronger.

M. dipsycha Pilsbry and Olsson appears to be the Panamic analog of *M. floridana*. *M. pilsbryi* Olsson and McGinty is *Vanikoro oxychone* Mörch (personal communication, Robert Robertson), and thus is not considered in the discussion of comparative characters of the West Indian species.

VITRINELLA TEXANA, sp. nov.

Pl. 7, figs. 4-6

Description. The shell is depressed, and has a flattened apex. The umbilicus is narrow but deep, and is almost flat sided. Sides of the shell curve out and down gently so that the periphery forms an angle with the base of the shell. The aperture is oblique.

The protoconch consists of $1\frac{3}{4}$ glassy whorls. The teleoconch consists of about $11\frac{1}{4}$ whorls, and is sculptured on the upper side with fine spiral grooves and on the lower side with numerous short radiating riblets. These riblets are crossed by a few weak spiral grooves, and there are several stronger spiral grooves in the umbilicus. The ventral side is flattened, and, in the holotype, bears about 36 radiating riblets. The riblets become indistinct on the last half of the whorl, and become difficult to count.

The aperture is oblique, and is broadly ovate. The peristome is deeply notched at the upper inner angle. The parietal wall is rather thick, and is extended a little forward of the aperture. The umbilicus is narrow and almost flat sided, but there is no angle with the base of the shell. The shell itself is quite thin and fragile, and only the holotype and one immature paratype are unbroken. One paratype is actually only half of the body whorl of a broken shell.

Material. Holotype. Mustang Island, near Port Aransas, Texas, February 14, 1960, collector, Winnie Rice; diameter, 1.72 mm.,

altitude, 0.78 mm. Deposited in the Division of Mollusks, U. S. National Museum, no. 636311. Paratypes. All collected by Winnie Rice on Mustang Island, Texas, near Port Aransas. 2 specimens from Cline's Point, Port Aransas, August 24, 1959; both are broken and have lost part of the body whorl. Institute of Marine Science, U. of Texas, no. 1015. 1 specimen from drift near the ferry landing, Port Aransas, September 2, 1959; this is a fragment consisting of about one half of the body whorl. Institute of Marine Science, U. of Texas, no. 1016. 1 specimen from Port Aransas, October 21, 1959; this is worn and broken. UMML no. 30:2775. 1 specimen from Port Aransas, October 26, 1959; this specimen has the upper part of the peristome broken away, and a piece is broken out of the body whorl close to the aperture — diameter, 1.9 mm., altitude, 0.8 mm. UMML no. 30:2776. 3 specimens from Mustang Island, February 14, 1960; 2 specimens are quite worn and broken, but one is quite fresh. The shell is glassy and unbroken except for a few nicks in the peristome. However, it is immature, and has the following measurements: diameter, 1.2 mm., altitude, 0.55 mm. One specimen Academy of Natural Sciences of Philadelphia no. 295622; 2 specimens Division of Mollusks, U. S. National Museum no. 636312.

Name derived from the state of Texas.

Remarks. The genus *Vitrinella* is as yet in a confused state, and it is not practical to attempt to enumerate all the species of the West Indian region at this time. However, no species of *Vitrinella* have as yet been reported from the Texas coast. Three species found in Texas waters are *V. helicoidea* C. B. Adams, *V. thomasi* (Pilsbry), and *V. floridana* Pilsbry and McGinty. None of these has the periphery at the base of the shell, nor do any have radiating riblets on the ventral side. Thus *V. texana* is quite distinct from other species of *Vitrinella* found on the coast of Texas.

SOLARIOBIS SEMIPUNCTUS, sp. nov. Plate 8, upper figs. 1-3

Description. The shell is strongly depressed, and has a flattened upper surface. The umbilicus is narrow, and partly concealed by a thickening of the body whorl around the umbilicus.

The protoconch apparently consists of $1\frac{1}{2}$ whorls, but this could not be determined with any degree of certainty. There are 3 whorls in all, covered, in the adult portion, with many spiral ridges. Between the ridges are somewhat narrower grooves. These

grooves are simple on the upper side but become punctate on the periphery and on the lower surface. The aperture is oblique, ovate, and with a rather heavy parietal callus. There is a notch in the upper inner angle of the aperture. The umbilicus is quite narrow, but deep. The thickening of the inner portion of the body whorl begins about half a whorl from the aperture. It may cover the umbilicus completely, or leave a small opening.

Material. Holotype. From northwest Campeche Bank, Mexico, 18 meters, mud bottom, collector, Dan Steger; diameter, 0.93 mm., altitude, 0.4 mm. Deposited in the Division of Mollusks, U. S. National Museum no. 636309. Paratype. 1 specimen from beach drift, Baie de Aquin, Haiti, 1956, collectors, Barry and Buena Valentine; diameter, 0.9 mm., altitude, 0.38 mm. UMML no. 30:2774.

Name. The name *semipunctus* is derived from the Latin, *semis*, a half, and *punctum*², a small hole, and refers to the series of small pits on the lower half of the shell.

Remarks. There are about 11 recent species of *Solariorbis* previously described from the West Indian region. *S. semipunctus* is smaller than any of the other known species, and is the only one with punctate sculpture on the lower half of the shell. *S. blakei* (Rehder) appears to be the most closely related species. It is only slightly larger than *S. semipunctus*, and may, in some specimens, also cover the umbilicus with an unusual development of the last whorl. *S. blakei*, however, does not have a flat upper surface, nor does it have the sculpture found in *S. semipunctus*.

Of the two specimens, the paratype from Haiti appears to be the more recently dead. The sculpture is beach worn, however, and not nearly so distinct as that found on the holotype. Little can be said about the distribution of the species except that the distance between the two localities leads one to believe that it must be widespread in the West Indies and adjacent continental coast.

REFERENCES

- Abbott, R. Tucker. 1950. The genus *Cyclostrema* in the western Atlantic. *Johnsonia* 2 (27): 193-200, pls. 86-88.
Bush, Katherine J. 1897. Revision of the marine gastropods referred to *Cyclostrema*, *Adeorbis*, *Vitrinella*, and related genera. *Trans. Conn. Acad. Arts. Sci.* 10: 97-144, pls. 22, 23.

² Actually the adjective *punctus*, pricked (punctate).—Ed.

- Fischer, Paul. 1857. Etudes sur un groupe de coquilles de la famille des Trochidae (Fin) 8. J. Conchyliol. 6: 284-288, pl. 10, figs. 10-13.
- Fretter, Vera. 1956. The anatomy of the prosobranch *Circulus striatus* (Philippi) and a review of its systematic position. Proc. Zool. Soc. Lond. 126 (3) : 369-381, figs. 1-5.
- Moore, Donald R. 1962. The systematic position of the family Caecidae (Mollusca: Gastropoda). Bull. Mar. Sci. Gulf & Carib. 12 (4) : 695-701, figs. 1-3.
- Pilsbry, Henry A. 1953. Vitrinellidae, Part 3a in Pliocene Mollusca of southern Florida with special reference to those from north Saint Petersburg. Acad. Nat. Sci. Philadelphia monog. 8: 411-438, pls. 49-56.
- Pilsbry, H. A. and T. L. McGinty. 1945. Cyclostrematidae and Vitrinellidae of Florida — 1. Nautilus 59 (1) : 1-13, pls. 1, 2.
- Taylor, D. W. and N. F. Sohl. 1962. An outline of gastropod classification. Malacologia 1 (1) : 7-32, fig. 1.
- Woodward, M. F. 1899. On the anatomy of *Adeorbis subcarinatus* Montagu. Proc. malac. Soc. Lond. 3: 140-146, pl. 8.

A NEW THYASIRA (PELECYPODA) FROM THE ROSS SEA, ANTARCTICA

By DAVID NICOL

Department of Geology, Southern Illinois University, Carbondale

Thyasiridae: *Thyasira* Lamarck, 1818

Type-species. (monotypy) *Tellina flexuosa* Montagu, 1803.

THYASIRA DEARBORNI Nicol, new species. Plate 8, lower figs. 1-2

Type repository — Division of Mollusks, U. S. National Museum. Holotype cat. no. 653099; paratypes cat. nos. 612770 and 635392.

Description—Shell thin, small, porcellanous, somewhat chalky; color varying from white to pale yellow; periostracum thin, yellow; a ferruginous, buff coating present at the anterior and posterior ends of the shell; equivalved; without a gape; anterior and ventral borders arcuate, postero-ventral area indented in the region of the constriction, remainder of posterior border gently rounded, dorsal border short and sloping both anteriorly and posteriorly; posterior one-eighth of the shell strongly constricted or flattened; holotype 4.8 mm. high and long, one paratype 4.9 mm. high and long, the other paratype 5.0 mm. high and 4.9 mm. long; no prodissoconch; beaks prosogyrate, contiguous; surface ornamentation consists of numerous concentric lines; interior margins of shell smooth; adductor muscle scars and pallial line not seen; ligament external, opisthodetic; hinge edentulous and hinge plate absent.

This species is named in honor of Mr. John H. Dearborn of Stanford University who collected the holotype and one of the two paratypes.

Comparisons — *Thyasira dearborni* can be easily distinguished from the more common *Axinopsida bongraini* (Lamy) by the prominent constriction on the posterior side of the shell, and this morphologic feature also distinguishes *Thyasira dearborni* from *Axinopsida magellanica* (Dall) because the latter species has only a shallow sulcus on the posterior side. *Thyasira falklandica* (E. A. Smith) is a much larger species with a well-developed greenish periostracum.

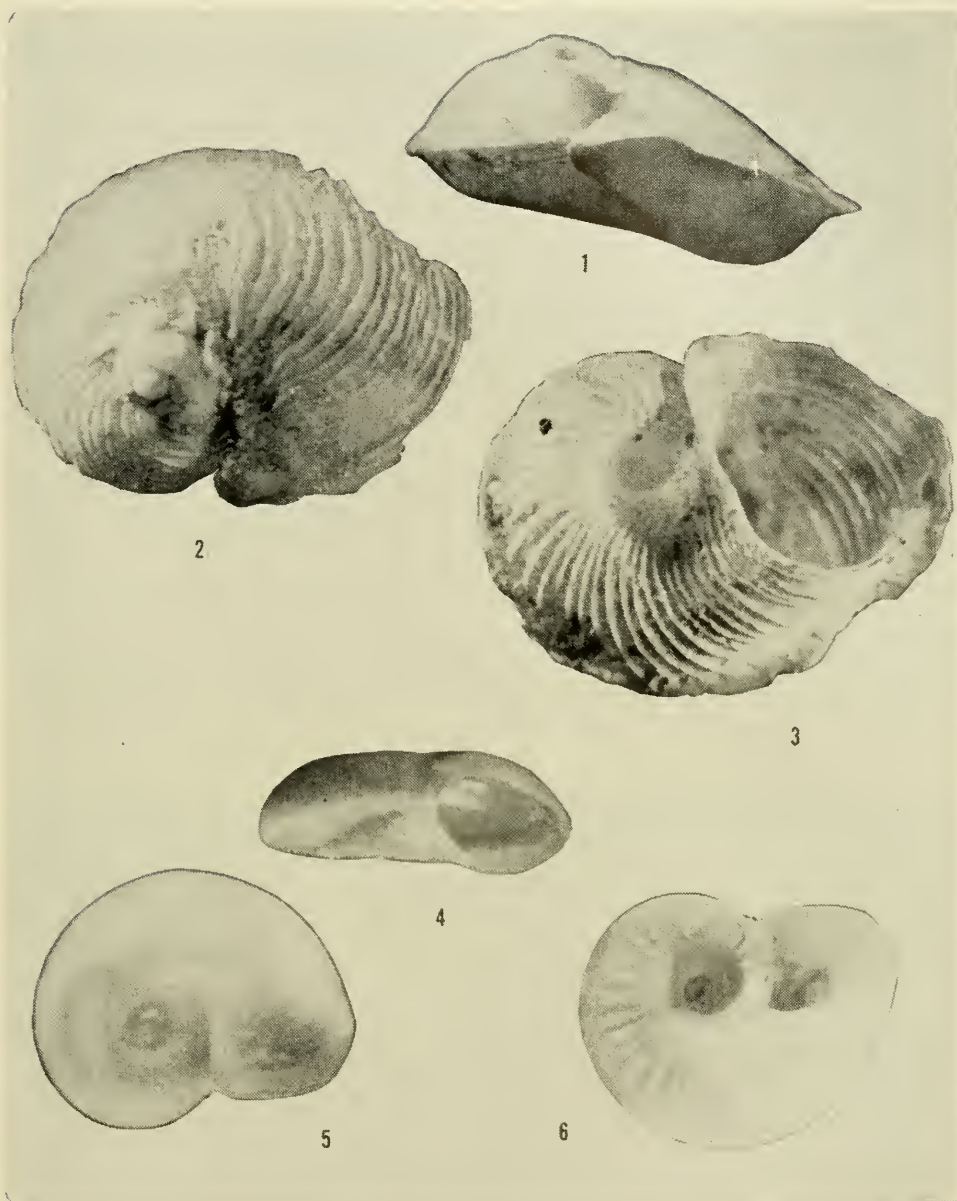
Habitat — The holotype was collected at a depth of 836 meters from a bottom of gravel and pebbles. One paratype was found at a depth of 695 m. associated with a sponge-gorgonacean complex. The other paratype was found at a depth of 640 m. on a bottom of coarse glacial till.

Geographic distribution—The holotype of *Thyasira dearborni* was discovered by Mr. Dearborn at 73°46.7'S., 169°09'E., off Coulman Island in the Ross Sea. One paratype, also found by Mr. Dearborn, came from 76°11.6'S., 164°46'E., in the Ross Sea. The other paratype was collected by the Deepfreeze I Expedition and came from 77°38'S., 163°11'W., Kainan Bay, Ross Sea. This uncommon species may be endemic to the Ross Sea region, and it certainly appears to live only in rather deep water—more than 600 m.

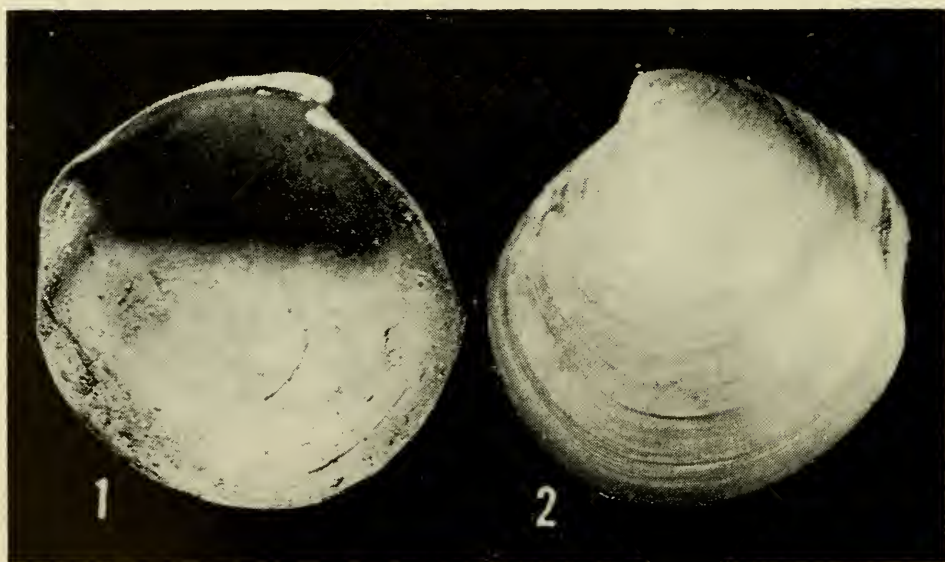
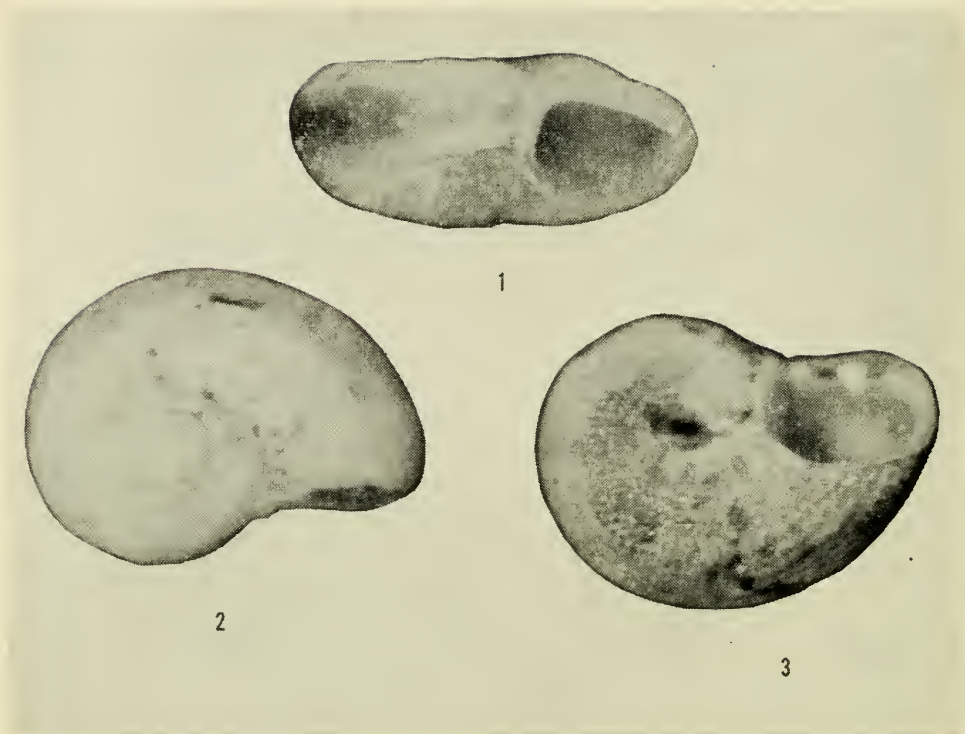
Mr. W. J. Byas, museum specialist in the Division of Mollusks at the U. S. National Museum, cleaned the holotype so that it could be photographed.

Mr. David H. Massie of the U. S. Geological Survey made the photographs of *Thyasira dearborni*.

This paper is a preliminary note on a study of antarctic pelecypods which is being supported by a grant from the National Science Foundation (G-13335).



Figs. 1-3, *Macromphalina floridana* Moore. 1, apertural, 2, upper, and 3, lower views. Figs. 4-6, *Vitrinella texana* Moore. 4, apertural, 5, upper, and 6, lower views.



Upper figs. 1-3, *Solariorbis semipunctus* Moore. 1, apertural, 2, upper, and 3, lower views. Lower figs. 1 & 2, *Thyasira dearborni* Nicol. 1, left valve, interior. 2, right valve, exterior.

MALACOLOGICAL PROBLEMS: 1

BY DEE S. DUNDEE AND PATTI WATT HERMANN

Louisiana State University in New Orleans and in Baton Rouge

During a field trip to Texas¹, the junior author collected a series of snails which we first called *Polygra septemvolva febigeri* (Bland). Upon checking further (Pilsbry, 1940), we discovered that there were snails in that lot matching the descriptions of *P. septemvolva*, *P. s. febigeri*, and *P. s. volvoxis*.

This confusion prompted us to check our other collections from the Gulf Coast area to see what the situation is there. Examining lots covering Texas through Florida, we were not surprised to find a similar situation in them. In fact, in some we discovered the further problem of not being able to distinguish the 3 above-mentioned ones from the non-laminate form of *P. cereolus carpenteriana* (Bland).

The table shows the size ranges in our collections.

Locality	Largest Individual			Smallest Individual		
	Ht.	Diam.	Whs.	Ht.	Diam.	Whs.
	mm			mm		
TEXAS						
Galveston	4.00	9.00	6.50	3.00	7.00	6.50
LOUISIANA						
New Orleans	3.50	8.50	5.50	3.00	7.50	5.50
New Orleans	3.50	9.00	6.25	3.00	7.50	5.75
Ft. Pike	3.50	8.50	6.25	3.50	7.50	6.50
MISSISSIPPI						
Pass Christian	3.50	8.00	6.00	3.00	7.50	5.75
Gulfport	3.25	8.00	6.00	3.00	7.50	5.75
Biloxi	3.75	8.50	6.25	3.75	8.00	5.75
Pascagoula	3.50	9.25	6.25	3.00	8.25	6.00
Mobile	4.00	9.75	6.25	3.00	6.50	5.50
Mobile	4.00	9.75	6.25	3.50	7.25	5.75
FLORIDA						
Pensacola	3.75	9.25	6.25	3.75	7.25	5.75
St. Augustine	3.50	8.50	6.50	3.75	6.75	5.75
Miami	3.50	8.50	5.75	3.00	7.50	6.00

¹ The collections mentioned here were made simultaneously with others which were sponsored by Public Health Service Grant GM-07194 (National Institutes of Health). To this agency we are indebted.

Evidently from the foregoing table, size ranges and measurements in general are no criteria on which to distinguish among these snails. This had already been pointed out by Vanatta (1912) when, after comparing measurements of *Polygyra cereolus* Muhl. and *P. c. carpenteriana* Bland in two collections, he stated,

"It will be seen that no definite division based on size as is the practice can be made. Each of these lots represents a single colony. . . ."

Walker (1928) listed 3 of these forms (*P. septemvolva*, *P. s. volvoxis*, and *P. s. febigeri*) from Mobile; Pilsbry (1940) said it seems doubtful that all these occur in Mobile and that a large series should be studied. Again, our findings from Mobile would seem to confirm Walker's statement that all 3 exist there. Pilsbry (1940) has pointed out the primary distinctions between these forms as being the following:

(1) *P. cereolus* differs from *P. c. carpenteriana* in that *P. cereolus* is larger and has more whorls but does not have the last whorl angular in front, sloping inward below the angle but becoming abruptly swollen in its last half or third and the rib striae not extending to the base as in *P. c. carpenteriana*.

He also points out that "practically all large lots afford complete series of intergrading sizes and forms, although intermediate sizes may form a minority."

(2) *P. cereolus* differs from *P. septemvolva* by having an internal lamina (although it may be reduced or occasionally absent in *P. c. carpenteriana*), being less acutely carinate and more calcareous, and in having central cavity of the base less widely open. *P. cereolus* occurs on calcareous soils while *P. septemvolva* is on acid soils. The ranges overlap.

(3) *P. septemvolva* differs from *P. s. volvoxis* by smaller caliber of whorls (in same diameter specimens), greater depression of the shell, greater number of whorls. "However, ambiguous specimens are occasionally found."

(4) *P. septemvolva volvoxis* differs from *P. s. febigeri* by having the area of the whorl below the peripheral angle flattened rather than convex as in *P. s. febigeri*. The central cavity is wider in *P. s. volvoxis* and the parietal callus is raised more than in *P. c. febigeri*.

Pilsbry earlier (1897) had considered *P. febigeri* a synonym of *P. s. volvoxis*.

In view of our observations and the conflicting impressions of just what each of these really is, apparently the entire *Polygyra cereolus* complex needs attention by a systematist.

Numerous small problems such as this exist in our own United States and could provide excellent short studies for students. The current trend is towards seeing an isolated, "untouched" spot in the world in which to work since the United States has been so well "worked over." From small problems such as this one, obviously such thinking is not valid.

Similar problems will be pointed out later.

LITERATURE CITED

- Pilsbry, Henry A. 1897. A classified catalog of American land shells, with localities. *Naut.* 11 (6) : 72.
—— 1940. Land Mollusca of North America (north of Mexico), *Acad. Nat. Sci. Philadelphia, Monogr.* 3, v. 1 pt. 2, 575-994.
Vanatta, E. G. 1912. Land shells of Southern Florida. *Naut.* 26 (2) : 16-22.
Walker, Bryant. 1928. The terrestrial shell-bearing Mollusca of Alabama. *Misc. Pub. No. 18, Mus. Zool., U. Mich.*: 1-180,

NEW RECORDS FOR NEW YORK AND NEW JERSEY

BY MORRIS K. JACOBSON

American Museum of Natural History

Triodopsis hopetonensis (Shuttleworth). In April, 1964, Mr. G. C. Colantonio of Jersey City found a large and apparently well-established colony of this snail in Sayreville, Middlesex County, New Jersey. This represents a considerable northward extension of this species. According to Pilsbry (p. 812) it ranges no further north than North Carolina. A subspecies, *T. h. chin-coteagensis* Pilsbry is found in Virginia, but the New Jersey shells do not have the small umbilicus and reduced apertural ornamentation characteristic of the Virginian form. They seem in all respects to be quite typical. Alexander (p. 57) does not cite it in his check list of New Jersey land snails. Mr. Colantonio reports that the colony is about 600 feet from the Raritan River, just beyond the railroad tracks. The area is an empty lot, low lying, with a few birch and oak trees. The snails are found on the ground, under leaves and twigs. The finder estimates that in the center of the colony, which is about an acre in extent, there were 5 individuals to the square foot. The only other mollusk

found was *Philomycus carolinianus* (Bosc).

Littorina irrorata (Say). Last autumn Mr. Colantonio discovered a sizeable colony of this species at the Manasquan Inlet Railroad Bridge in Monmouth County, New Jersey. Subsequently, Mr. Bernard Blum of Rockaway, New York, showed the writer one live specimen and one dead specimen of the same species that he had taken on June 17, 1964 in Jamaica Bay at Beach 65th Street. Both of these records are important because they refer to the northern part of the range of the species, where Bequaert (p. 7) feels they are dying out. Generally, northern records of this species are based upon dead material.

Valvata bicarinata Lea. The only *Valvata* ever recorded from the New York City area is *V. tricarinata* (Say) (Humphreys, p. 10; Jacobson and Emerson, p. 31, etc.). There are no Long Island records. This summer Mr. Harry Fertik of Bayside, Queens found *V. bicarinata* in Oakland Lake, a small body of water at Springfield Boulevard and Northern Boulevard in Queens County, New York City. The lake is small, about 4 city blocks long and about 2 wide. It is surrounded by a rather steeply rising shoreline which is thickly covered with deciduous trees. The snails were found in fair numbers in a few localities near shore crawling around on the surface of a very fine mud deposit. Where the mud was not present, the snails too were absent. The shells were quite typical, conforming well to the distinction from *V. tricarinata* pointed out by Walker (p. 122). The largest specimen measured 6.3 by 5.0 mm. As far as could be determined, the nearest locality from which *V. bicarinata* has been reported is Philadelphia, Pennsylvania (Walker, p. 125). The isolated presence of this snail in this one pond [none were found in Alley Pond, just a short distance away] suggests a recent and probably accidental introduction.

Viviparus contectoides Binney (= ? *V. georgianus* Lea). This species, found commonly further up state, appeared in Central Park some years ago (Jacobson and Emerson, p. 35). Mr. Fertik found this species associated with *Valvata bicarinata* in Oakland Lake. The specimens were smaller than those from Central Park, New York City but far less eroded. This is the first time this species was found in Long Island. The absence of the far more widespread *V. malleatus* from the lake is surprising. Seemingly there is hardly a permanent body of water in the New York City

area that does not support a sizeable colony of this immigrant from the Far East. Oakland Lake is an outstanding exception. Other mollusks found living in Oakland Lake are *Amnicola limosa* (Say), *Helisoma anceps* (Menke), *H. trivolvis* Say, *Physa heterostrophica* Say, and *Musculium* sp. The presence of large numbers of fishes indicates the probable presence of some naiads which have not yet been found.

Circulus liratus (Verrill). For several years, isolated specimens of this vitrinellid have been found dead in beach drift in Rockaway Beach. The only other records of this species are those of Verrill ("off Newport, Rhode Island, 8¼ fathoms," p. 529) and C. W. Johnson ("Cape Hatteras, North Carolina, 8 to 43 fathoms," p. 76). The determination of the specimens has been confirmed by Donald R. Moore of the University of Miami who is using the record in a study of the Vitrinellidae in which he is at present engaged.

Triodopsis fosteri F. C. Baker. Several years ago the writer visited Burlington, New Jersey and procured a series of this species that had been planted there by W. G. Binney about a century ago (Pilsbry, p. 832). Some were released in the writer's garden in Rockaway Beach where they have flourished amazingly, even exceeding the other imported snail *Cepaea nemoralis* (L.) (Jacobson and Smit, p. 2-4). It lives in a bed of ground ivy together with the *Cepaea*, *Discus rotundatus* (Müller) *Anguispira alternata fergusonii* (Bland) and several species of slugs.

Dr. William K. Emerson kindly read the manuscript. Specimens of the shells mentioned have been deposited in the collection of the American Museum of Natural History.

LITERATURE CITED

- Alexander, Robert C. 1952. *Nautilus*, 66: 54-59.
Bequaert, Joseph C. 1943. The genus *Littorina* in the western Atlantic. *Johnsonia*, no. 7: 1-28, pls. 1-7.
Humphreys, Edwin H. 1909. *Nautilus* 23: 10-11.
Jacobson, Morris K. and William K. Emerson. 1961. Shells of the New York City Area. Larchmont, New York, pp. i-xvii plus 1-142, illustrated.
Jacobson, Morris K. and Walter Smit, 1946. *Nautilus* 60: 2-4.
Johnson, Charles W. 1934. List of Marine Mollusca of the Atlantic coast from Labrador to Texas. *Proc. Boston Soc. Nat. Hist.* 4 (1): 1-204.
Pilsbry, Henry A. 1940. Land Mollusca of North America 1 (2):

iii-vi, i-ix [index], plus 575-994, figs. 378-580.

Verrill, A. E. 1882. *Trans. Connecticut Acad.* 5: 447-587, pls. 42-44, 57, 58.

Walker, Bryant. 1902. *Nautilus* 15: 121-125, figs. 1-7.

AN ECOLOGICAL ANALYSIS OF FOUR PERMIAN MOLLUSCAN FAUNAS

By DAVID NICOL

Department of Geology, Southern Illinois University, Carbondale

The reasons for the occurrence of predominantly molluscan faunas in some strata of Middle Permian age in the southwestern United States have received surprisingly little thought. Perhaps one explanation for this is that the reefs of Permian age have been considered economically more important and therefore merited more study than other Permian marine environments. The purpose of this paper is to point out why many typical marine organisms are rare or absent from these dominantly molluscan faunas.

Four examples of dominantly molluscan Permian faunas have been selected and compared with each other, and these in turn are compared with two possibly similar environments and faunas from the Recent along the coast of Texas. The 4 Permian faunas are found in the Fort Apache Limestone Member of the Supai Formation in eastern Arizona; the Alpha Member of the Kaibab Formation at Flagstaff, Arizona; the Blaine and Dog Creek Formations (which are essentially alike even to the same species) of Kansas, Oklahoma, and Texas; and the Whitehorse Sandstone of Oklahoma and Texas. These strata range in age from Early Leonardian to Middle Guadalupian. The Fort Apache is apparently Early Leonardian. The Kaibab and Blaine appear to be Late Leonardian. The Dog Creek is Early Guadalupian, and the Whitehorse is Middle Guadalupian in age. The Recent faunas from Texas are the hypersaline macrofauna from Laguna Madre and the brackish-water macrofauna from the Rockport region.

Two paragraphs in the book by Newell et al, 1953, provide us with some explanation of the reason for the unusual zoological composition of these faunas. (The writer realizes that these molluscan faunas were not the main consideration of Newell and his colleagues.) The first statement of interest in this problem is

given in the abstract (p. xviii-xix) and is as follows:

(10) For the most part, the rocks of the shelf province are poorly fossiliferous in the lower part and unfossiliferous in the upper part of the column. This is only partly a result of dolomitization and recrystallization. There are a few gastropods, brachiopods, scaphopods, and pelecypods, several of which also occur in the marginal and basin provinces. Evidently these forms were tolerant of a broad range of environmental conditions. Proximity to evaporite deposits suggests euryhalinity for the characteristic species of the shelf rocks. Groups which characteristically have always been stenohaline (corals, bryozoans, echinoderms, and ammonoids) are very poorly represented in the shelf faunas. Fusulines and, in the beds of Capitanian age, dasycladacean algae are abundant in the calcarenite zone immediately behind the banks and reefs, but they do not extend far from the edge of the Delaware Basin.

Essentially the same ideas are presented by Newell et al on p. 205 and are, therefore, not quoted here.

Newell (1940, p. 267) postulates the following type of physical environment for the Whitehorse Sandstone fauna, and conditions similar to this probably occurred in the Fort Apache, Kaibab, and Blaine and Dog Creek faunas.

The lagunal environment behind the offshore bars of a hypersaline sea might well be more habitable to invertebrates than the water on the seaward side of the barriers. Streams draining the arid lands bordering the relic sea, although few in number, would effectively reduce the salinity of the water along the coast bordering the stream mouths. Lagunal areas behind offshore bars near the streams might well become a haven for such relics of a normal marine fauna that could exist under the rather difficult conditions of environment.

On the basis of the evidence gleaned from both the lithology and the fossils, it is assumed that these faunas lived in almost completely land-locked, very shallow lagoons. On one side of each lagoon was an offshore bar; on the other was a low-lying arid land with few intermittent streams emptying into the lagoon. If this were a desert region, the rainfall would be little, but it would most likely come in great cloudbursts which would reduce the salinity in the lagoon at infrequent and irregular intervals. During most of the time, the salinity would be greater than that

Table 1. -- Number of species in each fauna.

	1*	2*	3*	4*	5*	6*
Pelecypoda	20	13	13	14	19	8
Gastropoda	29	7	2	12	20	6
Scaphopoda	1	1	1	1	0	0
Cephalopoda	2	3	14	0	0	0
Amphineura	0	0	0	0	1	0
Articulata	2	3	2	4	0	0
Bryozoa	1?	1**	2	1	0	0
Annelida	0	1	1	1	0	0
Trilobita	1	1	0	0	0	0
Crustacea	0	0	0	0	3	0
Echinodermata	2	0	1***	0	2	1
Anthozoa	1	0	0	0	0	0

1* Fort Apache Member, Supai Formation. 2* Alpha Member, Kaibab Formation. 3* Blaine and Dog Creek Formations. 4* Whitehorse Sandstone. 5* Recent, hypersaline, Laguna Madre. 6* Recent, brackish, Rockport. 1** one bryozoan fragment. 1*** one crinoid stem.

of normal sea water, but shortly after a heavy cloudburst the lagoon, or most of it, might have a salinity less than that of normal sea water (brackish water). Most of the lagoon might have been hypersaline but near the mouth of a large stream or river the water may have been brackish. The lagoons during the Middle Permian, like those along the south and central Texas coast today, were undoubtedly shallow. Maximum depth was probably about 10 meters in these lagoons and most of the lagunal areas probably had a depth of no more than 5 meters. Because the water was shallow with relatively little influx of water from the open sea, the seasonal and diurnal fluctuations of temperature must have been great. Parker (1959, p. 2108-2109) has recorded a yearly range of temperature in Laguna Madre of as much as from 5° to 40° C. Probably very similar fluctuations of temperatures occurred in the Middle Permian lagunal areas. These Permian faunas must have consisted of animals that were not only euryhaline but eurythermal as well. The greatest mortality of shallow water marine organisms commonly occurs at the maximum temperature rather than the minimum temperature because most organisms can withstand an extremely low temperature for a longer period of time than they can an extremely high temperature. These Permian organisms must have been able to withstand extremely high temperatures for at least short periods of time. Modern reef corals thrive when there is a yearly temperature fluctuation of not more than 5° C. One other limiting factor may have played a role in the composition of the Permian faunas, and that was type of substrate. Bottom conditions in the Permian lagoons were probably similar to those of the modern Laguna Madre, which has substrates of shelly sand, silty sand, clayey sand, and clay. These substrates would provide a good environment for the infauna and the vagrant benthonic organisms, but a rather poor environment for the epifauna and organisms that needed a hard object for attachment. However, the type of bottom in the shallow Permian lagoons was probably not so restrictive that it would completely eliminate all crinoids, corals, and bryozoans. Thus, the type of substrate was a less restricting factor than was the greatly fluctuating salinities and temperatures in these Permian lagoons.

This rather lengthy exposition on the probable physical conditions in which these Permian faunas lived is given mainly to

explain why some of the most abundant and widespread Permian invertebrates are absent or rare in the Fort Apache Limestone Member of the Supai Formation, the Alpha Member of the Kaibab Formation, the Blaine and Dog Creek Formations, and the Whitehorse Sandstone. If one assumes that these faunas are essentially marine, then their unusual composition should be explained, if it is at all possible. This, in essence, is the problem.

Let me analyze the faunal composition of each of the Permian faunas in some detail and compare them with the living ones at Laguna Madre and Rockport, Texas. Table 1, which lists the number of species in each fauna, can give us only a general idea as to the faunal composition in each case, but it clearly indicates that the pelecypods are either the most important element or one of the two most important elements in each of the six faunas. The basic data for these 6 faunas were taken from the following sources: Winters, 1963 (Fort Apache Limestone), Nicol, 1944 (Alpha Member of the Kaibab Formation), Clifton, 1942 (Blaine and Dog Creek Formations), Newell, 1940 (Whitehorse Sandstone), Parker, 1959 (Laguna Madre and Rockport, Texas). A better idea of the faunal composition and possible environment could be obtained by taking a sample and counting the specimens of the major groups in each fauna, but, unfortunately, such a count was made only in the Kaibab study.

The first fauna to be considered is the Fort Apache Limestone Member of the Supai Formation in eastern Arizona. This fauna is slightly older and richer than the other 3 Permian faunas and is more like the Kaibab fauna than any of the others.

Pelecypods and gastropods dominate the fauna, both in numbers of species and in numbers of specimens. Winters mentions 29 species of gastropods and 20 species of pelecypods in the Fort Apache Limestone. The most abundant ones (represented by 60 or more individuals) are six species of pelecypods, including one species of Protobranchia, and five species of gastropods. One of the two species of echinoids in the fauna is also listed as most abundant, but it apparently is represented only by spines and one interambulacral plate. The spines are not complete, and their condition suggests the possibility that they may have been transported into the Fort Apache Limestone after the death of the echinoids. Two species of nautiloids are described but neither is common. As in the other Permian faunas, one species of scaph-

opod is present. An unusual invertebrate found in the Fort Apache Limestone is a species of solitary rugose coral which is common at two of the four fossiliferous localities.

Only two species of articulate brachiopods are present and only one of them is abundant. This is certainly a poor representation for the brachiopods in a marine environment during the Permian. Apparently at least one species of bryozoan is found at one locality (p. 21-22), but it is not mentioned by Winters in his section on systematic paleontology. One species of trilobite, represented by only three fragments of pygidia, is found in the Fort Apache Limestone. The Kaibab Formation, also in Arizona, contains trilobites, too; but the other two Middle Permian faunas discussed in this paper have no trilobites, although they were ecologically similar and geographically close. This fact again substantiates the observations of other writers who have noted that, throughout the Permian, relict trilobites exhibit endemic geographic distribution. Some kind of unknown selective barrier that prevented the trilobites (but not many other organisms) from spreading eastward, is also a possible explanation for the absence of trilobites in the Blaine and Dog Creek Formations and the Whitehorse Sandstone in Kansas, Oklahoma, and Texas.

Pelecypods and gastropods almost completely dominate the fauna of the Alpha Member of the Kaibab Formation, both in numbers of species and in numbers of individuals. The number of specimens counted was as follows: pelecypods 198, gastropods 125, scaphopods 50, brachiopods 36, trilobite 7, cephalopods 5, annelids 1, bryozoans 1 poorly preserved fragment. The writer now doubts that either the few nautiloid cephalopods or the one bryozoan fragment were indigenous to the area and believes they were probably transported after death into this region; they should be eliminated from further consideration in the analysis of the Kaibab fauna. Accordingly, the adjusted number of identified specimens is 417, including 373 pelecypods, gastropods, and scaphopods. Mollusks comprise about 89 per cent of the total number of specimens in the fauna. A further breakdown of the various components of the Kaibab fauna is as follows: pelecypods 47 per cent, gastropods 30 per cent, scaphopods 12 per cent, and articulate brachiopods 8 per cent. The Kaibab fauna is, thus, a predominantly molluscan one dominated, on the basis of number of species and individuals, first by the pelecypods and secondarily

by the gastropods. The articulate brachiopods are a minor element on the basis of number of species and number of individuals.

The Blaine and Dog Creek faunas differ from the Fort Apache, Kaibab, and Whitehorse faunas in two significant ways. One is the abundance and variety of cephalopods and the other is the scarcity of gastropods (Clifton, 1944, p. 1027). The pelecypod specimens and species dominate the Blaine and Dog Creek faunas because the cephalopods are more restricted in both their stratigraphic and geographic distributions. One cannot be certain that the cephalopods were not washed into these lagunal deposits through inlets in barrier bars after death and are therefore not indigenous to these Middle Permian strata. The crinoid stem very likely came from outside the barrier bar and was washed into these deposits. Two species of articulate brachiopods are found at one of the 5 fossiliferous localities in the Dog Creek Formation but are completely absent from the Blaine Formation. One of the two brachiopod species is represented by one specimen and the other is reported as scarce. The uncommonness of gastropods is a most unusual feature of the Blaine and Dog Creek faunas, and the only factor that might have restricted the number of gastropods in these faunas was the soft muddy substrate.

Newell (1940, p. 269) has this to say about the composition of the Whitehorse fauna.

The Whitehorse fauna is predominantly molluscan, 26 out of a total of 32 forms being pelecypods and gastropods. Pelecypods dominate the fauna in both variety and numbers. Two pelecypod species, *Dozierella gouldii* (Beede) and *Pleurophorus albequus* Beede, make up more than $\frac{3}{4}$ of all specimens found. There are 14 kinds of pelecypods and 12 gastropod species.

Calcareous worm tubes belonging to *Spirorbis* sp. are fairly common, as are specimens of the one bryozoan species *Lioclema dozierense* Moore. Brachiopods are represented by 4 species, none of which is abundant.

It is interesting to note that each of the 4 Permian faunas has one species of scaphopod. Scaphopod individuals are fairly abundant in the Kaibab fauna (50 specimens observed) but only two specimens were found in the Whitehorse Sandstone, and they are scarce to common in five localities in the Blaine and Dog Creek Formations. They are also common at two fossiliferous localities

and rare or very rare at two other fossiliferous localities in the Fort Apache Limestone. Except for the Fort Apache, one species of annelid worm occurs in each fauna, but they are never more than fairly common. Bryozoans apparently are not indigenous to the Kaibab Formation, and this may also be true of the Fort Apache Limestone. Bryozoans are not common in the Blaine and Dog Creek Formations and only fairly common in the Whitehorse Sandstone. The brachiopods in all four faunas are articulate forms, and one species of productid occurs in each of the four faunas except the Whitehorse Sandstone, where only terebratulids and athyrids occur. No linguloid brachiopods are present, and the reasons for their absence may be either a scarcity of slightly brackish water habitats or lack of the proper muddy substrate in which these brachiopods prefer to live.

Brachiopods are not abundant as to numbers of individuals in the Kaibab Formation, and they occur only rarely at one locality in the Dog Creek Formation. They are not found in the Blaine Formation, nor are brachiopods abundant as to individuals in the Whitehorse Sandstone, where they have been found in only three of the eleven fossiliferous localities examined. Only one of the two species of articulate brachiopods from the Fort Apache Limestone is abundant. A unique feature of the Fort Apache and Kaibab faunas is the presence of trilobite pygidia in these beds. Some of the few species of trilobites living during Middle Permian time might have been able to endure rather euryhaline and eurythermal conditions. However, there is again the possibility that these pygidia may have been washed into these lagunal deposits from the open sea. A more detailed analysis of the pelecypod faunas of these Permian strata reveals that there are no protobranchs in the Whitehorse fauna; only one species is found uncommonly at three localities in the Blaine and Dog Creek Formations; one species occurs abundantly in the Fort Apache Limestone; and two species (32 specimens of undoubted protobranchs) are found in the Kaibab fauna. Only 16 per cent of all the individual pelecypods counted in the Kaibab fauna were protobranchs. Thus, the nuculids and their allies do occur in most of these Permian molluscan faunas, but they are never the dominant subclass of pelecypods.

In the Recent hypersaline fauna of Laguna Madre, the pelecypods are commonly the dominant group from the standpoint

of numbers of individuals because 9 of the 19 species listed by Parker are considered by him to be exceedingly abundant. The gastropods follow rather closely and 5 of the 20 species are exceedingly abundant as to numbers of living individuals. The one species of *Amphineura* listed is rare, and neither species of echinoderm is common. One species of Crustacea is considered exceedingly abundant by Parker. Only one of the 19 species of pelecypods listed is a protobranch, and it is not common in any hypersaline environment. Thus, the faunal composition of the hypersaline fauna of Laguna Madre is similar to those of the Fort Apache, Kaibab, Blaine and Dog Creek, and Whitehorse Permian faunas; and the similarity is particularly remarkable when one considers that approximately 200 million years in age separates the Permian faunas from the one at Laguna Madre.

The brackish-water fauna in the Rockport, Texas, region is a more impoverished one than is the hypersaline one at Laguna Madre, and it is more completely dominated by species and living individuals of pelecypods. Five of the 8 species of pelecypods are exceedingly abundant according to Parker but only two of the six species of gastropods are exceedingly abundant. No species of protobranchs taken alive are reported from this brackish-water fauna. Strangely enough, the one species of echinoderm is also exceedingly abundant. Perhaps the similarity of the Recent Rockport fauna to some of the more impoverished Permian faunas, which are commonly dominated by a few species of pelecypods, can be attributed to below-average salinity in both cases.

Before concluding, it is interesting to note that those groups of invertebrates that are absent or are poorly represented in the four Permian molluscan faunas are generally the ones that suffered most from the rapid world-wide extinction at the end of the Permian. The fusulinids and Paleozoic corals became extinct at the end of the Permian, and so did some of the important classes and orders of Paleozoic echinoderms. The bryozoans, likewise, suffered much extinction, and the cephalopods also nearly became extinct although they recovered rapidly in the Triassic. The brachiopods, of course, declined rapidly in numbers of species, genera, and families at the end of the Paleozoic. The trilobites cannot be considered in this light because they were nearly extinct before the extremely unfavorable conditions in the Per-

mian took place, but this may have hastened their extinction. In other words, these molluscan faunas that occur in the Permian adumbrate the dominant invertebrate faunal types found in the Early Triassic. The Early Triassic marine faunas are dominated by abundant and widely distributed pelecypods.

Gastropods and cephalopods may be abundant in some areas, but they generally are not as common as the pelecypods. Corals are absent from the Early Triassic. The brachiopods, possibly because they were not nearly so commonly euryhaline and eurythermal as the pelecypods, no longer were more varied and abundant than the latter group. Thus the molluscan faunas of the Permian herald the changes of faunal dominance from Triassic time onward.

LITERATURE CITED

- Clifton, R. L., 1942, Invertebrate faunas from the Blaine and the Dog Creek Formations of the Permian Leonard Series: *Jour. Paleo.* 16 (6) : 685-699.
- , 1944, Paleoecology and environments inferred for some marginal Middle Permian marine strata: *Am. Assoc. Petr. Geol., Bull.* 28 (7) : 1012-1031.
- Newell, N. D., 1940, Invertebrate fauna of the Late Permian Whitehorse Sandstone: *Geol. Soc. Am. Bull.* 51 (2) : 261-335.
- Newell, N. D., J. K. Rigby, A. G. Fischer, A. J. Whiteman, J. E. Hickox, and J. S. Bradley, 1953, The Permian reef complex of the Guadalupe Mountains region, Texas and New Mexico. A study in paleoecology: W. H. Freeman & Co., San Francisco, Calif., 236 pp.
- Nicol, David, 1944, Paleoecology of three faunules in the Permian Kaibab Formation at Flagstaff, Arizona: *Jour. Paleo.* 18 (6) : 553-557.
- Parker, R. H., 1959, Macro-invertebrate assemblages of central Texas coastal bays and Laguna Madre: *Am. Assoc. Petr. Geol., Bull.* 43 (9) : 2100-2166.
- Winters, S. S., 1963, Supai Formation (Permian) of eastern Arizona: *Geol. Soc. Am., Memoir* 89, 99 p.
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MESODESMA DEAURATUM: SYNONYMY,
HOLOTYPE AND TYPE LOCALITY¹

By JOHN D. DAVIS

Department of Zoology, Smith College

Recently (Davis 1964) a lectotype was designated for *Mesodesma arctatum*, one of the two arctic wedge clams found in the western North Atlantic. Attention is now turned to the companion species, *Mesodesma deauratum*.

The following synonymy has been established:

MESODESMA DEAURATUM (Turton) Plate 9, fig. A-D

Macra deaurata Turton 1822, The Bivalve Shells of the British Islands, Exeter, England, p. 71, pl. 5, fig. 8 (Exmouth [England]).

Macra denticulata Wood 1828, Index Testaceologicus, 2nd. ed. Supplement, p. 4, pl. 1, fig. 9, (no locality given).

Mesodesma jauresii De Joannis 1834, Magasin de Zoologie (Guerin), Paris, pl. 54, [no pagination].

Mesodesma deaurata Turton. Hanley 1843, Catalogue of Recent Bivalves, London, p. 39.

Ceronia deaurata H. and A. Adams 1857, The Genera of Recent Mollusca, London 2:414.

Turton's original description follows:

"MACTRA *testa oblonga depressa inaequilaterali, latere pro-
ducto rotundato altero subtruncato, umbonibus incurvis.*

"Shell oblong flattish inequilateral, rounded at the elongated side and somewhat truncate at the other, with the beaks incurved. *Tab. nost.* 5, g. 8.

"*Mus. nost.* Dredged up in the offing of Exmouth.

"Shell five-eighths of an inch long, and an inch and a quarter broad, opaque and strong; one side elongated, sloping from the beaks, and rounded; the other shorter and somewhat angular, where it is a little open: color dull greyish-white, covered with a shining bronzed skin reflecting metallic lustres; coarsely and irregularly striate transversely, with a few coarser ridges towards the hinge: inside glossy greyish white, with the margin plain: beaks rather prominent and pointed, a little inclining to the longer side.

"Of this very beautiful shell we know neither description nor figure. In the outline it something resembles the *Macra dealbata* described in the eighth vol. of the Linnean Transactions, p. 68, tab. 1, fig. 10, and the Dorset Catalogue, tab. 7, fig. 7. But

¹ Contribution no. 251 from the Smith College Department of Zoology.

that shell is represented as thin and transparent, and somewhat angular at the *longer* side: the teeth also appear to be different."

In 1834, De Joannis published his description of *Mesodesma jauresii* from the Gulf of St. Lawrence. His description follows:

"Mesodesme. *Mesodesma*. Deshayes. M. de Jaurès. *M. jauresii*. Joannis.

"Long. 4 décim.; haut. 27 mill.; épais. 17 mill.

"Coquille assez épaisse epidermée, couverte de rides produites par les stries d'accroissement équivalve très inéquilatérale, fortement tronquée en arrière (à la manière de quelques Donaces); la partie inférieure du limbe légèrement sinueuse; ligament postérieur externe se prolongeant à l'intérieur, et y occupant le fond d'un cuilleron cardinal et très profond. Deux dents subcardinales obliques, striées transversalement sur la valve gauche et portant à leur pied une fossette oblongue, striée en dedans sur la droite. La dent antérieure plus allongée que la postérieure, et soutenue en dessous par un épaississement du test. Deux impressions musculaires, submarginales, réunies par une ligule paléale étroite, et portant un petit sinus semi-circulaire en arrière.

"Patrie, l'embouchure du fleuve Saint-Laurent.

"À l'époque où l'on décrit cette coquille, on ne l'avait encore que privée de son épiderme, et en partie dégradée par l'action des eaux. Elles pendaient en grappes à des fucus qui s'étaient implantés dessus. Cette agglomération en grappes n'existe point évidemment dans leur état vivant."²

Hanley (1843) first suggested that *Mactra deaurata* was not a member of the Mactridae but of Deshayes' new genus *Mesodesma*. Accordingly, he introduced the name *Mesodesma deaurata*. However, it remained for Stimpson (1851) to suggest that *Mactra deaurata*, *Mesodesma deauratum* and *Mesodesma jauresii* were all synonyms. The issue was settled two years later when Forbes and Hanley (1853) published the following account:

"Under the name of *Mactra deaurata*, Dr. Turton has introduced into our Fauna a species of the genus *Mesodesma*, stating that it was dredged up in the offing of Exmouth. One of our most assiduous and scientific collectors, Mr. Clark of Bath, whose researches in that neighborhood extended over a period of twenty years, during that long space of time never once procured a single specimen, a strong, although negative, proof of the individual shell described by the doctor being of foreign importation, and not of native origin. The species is an inhabitant of the Gulf of St. Lawrence, Newfoundland, and does not range to the European seas. Inquiries instituted on the Devonshire coast have

² Lack of accents graves not author's fault. Ed.

enabled us to solve the mystery of the discovery of this and other transatlantic shells in spots so utterly at variance with their known habitats. We find that during many years several vessels from those parts were engaged in prosecuting the Newfoundland fisheries; so that the accidental appearance of a few specimens of northern shells may readily be accounted for, as they frequently are mingled with the ballast of ships. A comparison of the original type with its delineation in the *Conchylia Dithyra*, compels the remark, that it is represented as more narrow and elongated than nature has shaped it, and enables us to declare its perfect identity with examples of the *Mesodesma jauresii*, received by us from North America."

Thus the representatives of the Mesodesmatidae in the western North Atlantic were reduced to two species, *Mesodesma arctatum* and *Mesodesma deauratum*.

At the same time, Gray (1853) divided the Mesodesmatidae into two groups based on the existence of a pallial sinus. The forms with a "siphonal inflection" included *Mesodesma*, *Taria*, *Donacilla*, *Paphia*, and *Ceronia* (a new genus created by Gray). The genera without a sinus were *Anapa* and *Davilia*. Observing that Gray described the lateral teeth of *Ceronia* as "strongly cross-grooved," H. and A. Adams (1857) suggested 4 species, *C. arctata* (Conrad), *C. donacia* (Lam.), *C. jauresii* (Joannis) and *C. lanceolata* (Deshayes). Later, Dall (1896) discussed the family Mesodesmatidae in detail and concluded that *Ceronia* and *Mesodesma* were synonyms. Subsequently, the name *Ceronia* was abandoned.

Mr. S. P. Dance of the British Museum has informed me (personal communication) that there are no records of *M. deauratum* being found on British shores subsequent to the discovery described by Turton in 1822. Thus *Mesodesma deauratum* is probably confined to the waters of the western North Atlantic. More specifically, distributional information from museums in the United States and Canada indicates that *M. deauratum* is probably restricted to the St. Lawrence estuary and the Gulf of the St. Lawrence.

M. deauratum can be distinguished from *M. arctatum* by its less truncate posterior end. In other words, the posterior edge of *M. arctatum* usually plunges more sharply to the ventral margin. Because of marked variation in the degree of truncation of both species, separation of the two species on the basis of this morphological variation is at best indistinct.

During the study of museum collections a pair of valves was found in the United States National Museum with a label indicating the specimen was originally a part of Turton's collection. The label also indicated that the valves had previously been a part of the Jeffreys collection. Inasmuch as Jeffreys acquired the entire Turton collection, quite possibly this specimen might have been the one used by Turton in making his initial description.

Further investigation confirmed this. Comparison of the exterior of the left valve with the drawing accompanying the original description leaves no doubt about the specimen being the one used by Turton. The left valve and the drawing coincide exactly, both in size and shape, and the pattern of the remaining periostracum is very similar on both. Most convincing, however, is the appearance of a similar growth aberration on both picture and valve. Below and slightly posterior to the umbo, the third and fourth growth rings fuse forming a noticeably wider ridge and deeper groove.

Therefore, this specimen (shown in Plate 9, figs. A-D) is designated as the original type used by Turton, or as a modern lectotype. The museum label accompanying the specimen reads as follows: "*Mesodesma deaurata* Turt. Ex. Mus. Turton. Jeff. Coll." USNM. No. 172665.

The type specimen consists of paired right and left valves, length 27.9 mm., height 17.1 mm. The posterior edge is not sharply truncate but rather extended, and does not plunge sharply to the ventral margin. The dorsal margin is relatively straight and connects with the ventral margin at the rounded anterior end. The beak or umbo region is closer to the midpoint of the shell than in *M. arctatum* primarily because of the less truncate posterior end of *M. deauratum*. The concentric lines of growth spreading outward from the beaks are quite pronounced and easily visible. The previously mentioned fusion of the third and fourth growth rings is apparent on both valves. Considerable periostracum persists on the periphery of each valve.

On the inner side of each valve there is a large cartilage pit or chondrophore in the beak region. On the left valve are two lateral teeth. Each of these consists of a ridge running parallel to the margin of the valve and covered with many vertical ridges. The anterior lateral tooth is somewhat longer than the posterior lateral tooth. The right valve has a posterior and anterior lateral

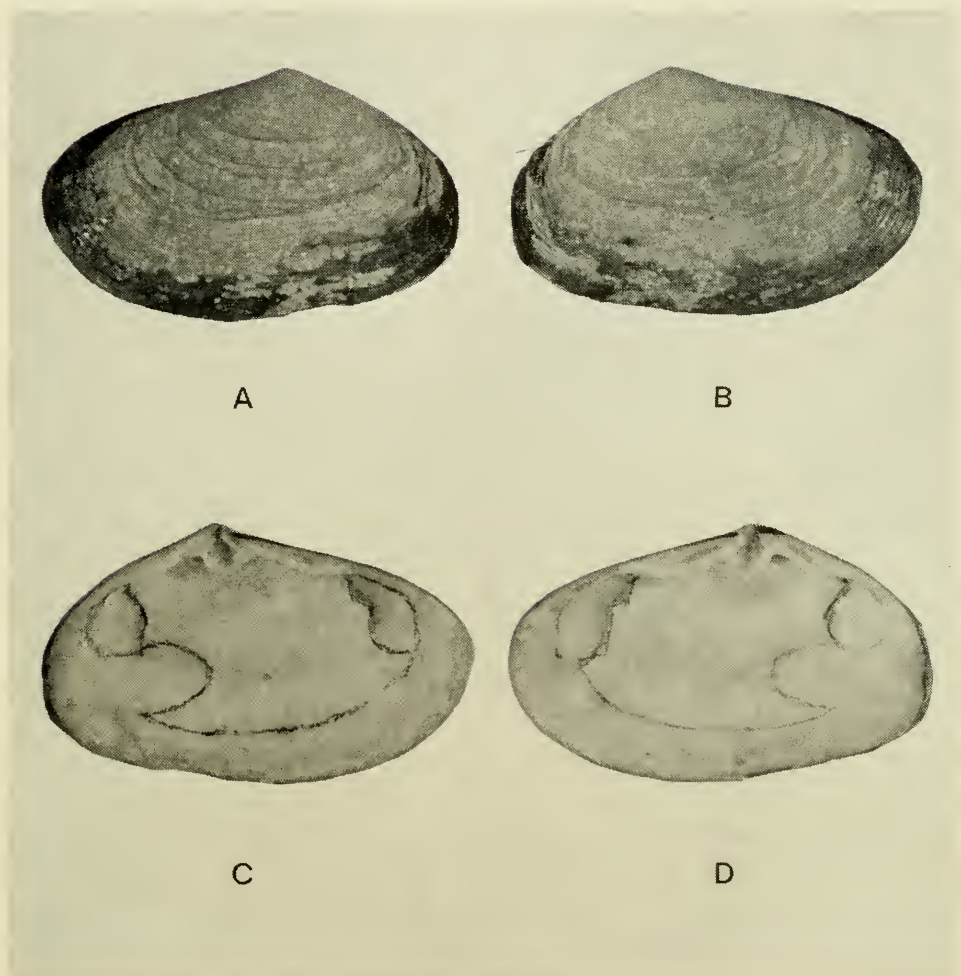
groove similarly ridged and positioned to receive the lateral teeth of the left valve. A complete pallial line includes a shallow U-shaped sinus posteriorly. The anterior adductor muscle scar has an anterior convex side and a posterior concave side, whereas the posterior adductor muscle scar is almost spherical with a small dorsal portion partially set off by an indentation on the anterior side of the scar.

The question of type locality also needs consideration. Turton's original specimen was collected off Exmouth, on England's south coast. *M. deauratum* is not believed to live there at the present time. Therefore, it seems desirable to note the source of the original specimen and then designate as the type locality an area known to support a large population of *M. deauratum* today. For this reason, Petite Matane, Province of Quebec, Canada, is designated as the type locality for *Mesodesma deauratum*. This site, on the south shore of the St. Lawrence estuary, supports a massive population of this pelecypod mollusk.

I wish to thank Dr. William J. Clench for reading the manuscript and for his helpful suggestions. Appreciation is expressed to Drs. Harald A. Rehder, Curator of the Division of Mollusks, United States National Museum, and T. D. Stewart, Director, Natural History Division of the Smithsonian Institution, for their loan of the type specimen. I also wish to thank Mr. Norman Tebble and Mr. S. P. Dance of the British Museum for additional information on possible British occurrence of the species.

REFERENCES

- Adams, H. and A. Adams. 1857. Sub-family Paphiinae, p. 412-415. *In*: The genera of Recent Mollusca. Vol. 2, Van Voorst, London.
- Dall, W. H. 1896. Contributions to the Tertiary fauna of Florida (Family Mesodesmatidae). Wagner Free Inst. of Sci., Trans. 3:907-913.
- Davis, J. D. 1964. Lectotype designation for *Mesodesma arctatum*. Nautilus, 78:3-6.
- Forbes, E. and S. Hanley. 1853. *M. deaurata* Turton, p. 346-347. *In*: A history of British Mollusca. Vol. I Van Voorst, London.
- Gray, J. E. 1853. *Ceronia*. *In*: Ann. Mag. Nat. Hist. (s. 2) 11:44.
- Hanley, S. 1843. An illustrated and descriptive catalogue of recent bivalve shells. 6 pts. [Published in separate sections from 1842 to 1856].
- Stimpson, W. 1851. Shells of New England. Phillips, Sampson and Co. Boston. vi + 58 p.



Mesodesma deauratum (Turton). Holotype, U. S. N. M. 172665. A, exterior of left valve. B, exterior of right valve. C, interior of left valve. D, interior of right valve.



Latiaxis

A NEW LATIAXIS FROM THE WESTERN PACIFIC (MURICIDAE)

BY WILLIAM K. EMERSON AND ANTHONY D'ATTILIO
American Museum of Natural History

Commercial pearl-shell divers have obtained in recent years many specimens of an apparently undescribed species of *Latiaxis* from off the northeast coast of Australia, near Cooktown, Queensland. Specimens of this species, masquerading as "*Lataxiens lataxiens* Jousseaume," are now available to private collectors in Australia and the United States. Therefore, it is appropriate at this time to describe this long-neglected species.

According to Dr. D. F. McMichael of the Australian Museum, a specimen of this species has been represented in the collection of his institution for many years. Charles Hedley (1909: 369) cited it from Cooktown under the name of *Coralliophila imbricata* (Smith), 1876. Dr. McMichael concurs with our belief that this species is not referable to Smith's taxon and he kindly suggested that we describe it.

We take pleasure in naming this species for Mr. Jack Fearnley of Cooktown, Australia, to whom we are indebted for providing most of the specimens used in this study.

LATIAXIS (BABELOMUREX) FEARNLEYI, new species. Figs. 1-4, 6

Coralliophila imbricata Smith, Hedley, 1909, p. 369.

Not *Fusus imbricatus* Smith, 1876, p. 540, pl. 30, fig. 3.

Shell is large for the genus, robust, high spired, fusiform, with 8 to 10 highly imbricated and angulated whorls; exterior is greyish buff white. Protoconch is apparently simple, but is not well preserved. A spiney keel is commonly developed at the shoulder of the body whorl. Axial sculpture consists of 8 undulating ridges spirally crossed by numerous ribs. All major ribs are of nearly equal size and are divided by a minor rib. Spiral sculpture consists of numerous scaly processes which are most strongly developed at the intersections formed with the axial ridges. Whorls on the spire have 3 major spiral ribs above the shoulder and 3 below; on the body whorl there are 3 to 4 spiral ribs above the shoulder and 10 below, followed by 3 additional ribs on the siphonal canal, the central one being the most prominent. These ribs are crowdedly ornamented with large scaly spines, with the spine open on one side and with the rounded opposite side set with

additional numerous vaulted scales. Shoulder-spines, which coincide with the axial ridges, are relatively large; the spines are triangularly shaped and are adapically turned. The spines below the shoulders of the whorls, gradually diminish in size and become progressively more depressed on the basal part of the body whorl; spines on the siphonal canal increase in size and project at right angles from shell. The siphonal canal is moderately open, long, recurved. The wide pseudo-umbilical region is roughly laminate and is bordered by a flaring fasciole set with close scales and the ends of previously formed canals. Aperture is small, ovate, angulate posteriorly, being about $\frac{1}{4}$ the height of shell; the outer lip is crenulate and lirate within. The entire aperture and inner surface of canal is colored a uniform shade of medium violet. No opercula were available for study.

Measurements: holotype, length 61.9, diameter (below the keel of body whorl) 31.2 mm.; largest paratype, length 67.3, diameter 31.3 mm.; smallest paratype, length 27.2, diameter 14 mm.

Type locality: in 8 fathoms, on broken coral bottom, 1 mile northwest of Dawson's Reef, which is 7 miles southeast of Cooktown, Queensland, Australia.

Specimens examined: Holotype (A.M.N.H. No. 111976) and 14 paratypes (2 A.M.N.H., 7 A. D'Attilio and 4 B. F. Grunzig collections) from type locality, *ex* J. Fearnley 1 paratype (Aust. Mus. No. 25110) off Cooktown, Queensland, C. Hedley. 1 paratype, 56.3×30.2 mm. (A.N.S.P. No. 297260), 20 fms., off Cooktown. 2 paratypes (Aust. Mus. No. 64476) off Cooktown, Queensland, *ex* P. Colman. 1 specimen, Gloucester Island, Bowen, Queensland, N. Buckland collection. 1 specimen, Peel Island, Moreton Bay, Queensland, V. Christiansen collection.

This species, which is the largest known living representative of *Latiaxis* (*s. l.*) appears to belong to a group of *L.* (*Babelomurex*), including *L. australis* (Laseron), 1955, from southeast Australia and *L. japonicus* (Dunker), 1882, from Japan. The large size, prominent scaly spines, violet aperture, and relatively slight development of the shoulder keel, however, serve to characterize *L. fearnleyi* (figs. 1, 2).

This species is known to range off Queensland, Australia from near Cooktown on the north coast to Moreton Bay, near Brisbane, on the south coast. Three specimens of a *Latiaxis* in the junior author's collection from 10 fathoms in Kii Channel resemble the present species, but the Japanese specimens possess somewhat less markedly imbricated scales and a paler colored

aperture (figs. 5, 7, 8). Additional collecting in Japanese waters may demonstrate that these are immature examples of *L. fearnleyi*. Another specimen from Japan was figured by Shikama and Horikoshi (1964, pl. 62, fig. 13) from off Shinomisahi, Kii Channel, Japan and was misidentified as *Coralliophila* (*Latimurex*) *costularis* (Lamarck), 1816. Compared to *L. fearnleyi*, Lamarck's species, however, has a much smaller shell, which is a paler white, has a bluish purple aperture, whorls that are more rounded, axial sculpture that is more prominent, and scaly ornamentation that is more weakly developed (figs. 9-12).

In addition to Dr. McMichael and Mr. Fearnley, we are indebted to several people for assistance in the completion of this study, Dr. R. T. Abbott permitted access to collections of the Academy of Natural Sciences of Philadelphia. Mr. Peter Dance checked the collection of the British Museum (Natural History) for pertinent specimens. Mr. B. F. Grunzig of Avenel, New Jersey, Mr. A. Teramachi of Kyoto, Japan, and Mr. S. Kinoshita of Shirahama-Onsenjo, Japan, provided specimens. Mr. W. E. Old, Jr. of the American Museum of Natural History assisted in various ways.

LITERATURE CITED

- Hedley, Charles. 1909. The marine fauna of Queensland. Rept. Austr. Assoc. Brisbane 12:329-371.
Shikama, Tokio, and Masuoki Horikoshi. 1964. Selected shells of the world, illustrated in colours. Tokyo, Japan, 154 pp., 211 text figs., 102 pls. in color.
Smith, E. A. 1876. A list of marine shells, chiefly from the Solomon Islands, with descriptions of several new species. Jour. Linn. Soc. London 12:535-562, pl. 30.

EXPLANATION OF PLATE 10

Figs. 1-4, *Latiaxis* (*B.*) *fearnleyi* from off Cooktown, Australia, type locality; figs. 1, 2, holotype; figs. 3, 4, small paratype; fig. 6, paratype.

Figs. 5, 7, 8, *L.* (*B.*) cf. *L.* (*B.*) *fearnleyi*, Kii Channel, Tosa Bay, Japan, 10 fathoms.

Figs. 9-12, *Latiaxis* (*Latimurex*) *costularis* (Lamarck); figs. 9, 10, Kii Channel, Japan, 10 fathoms; figs. 11, 12, Zanzibar, intertidal. All figures natural size.

NOTES AND NEWS

DR. KEPPEL HARCOURT BARNARD died suddenly on Sept. 22, 1964. He had worked at the South African Museum since 1911, and was the Director from 1946 until his retirement in 1956. He was engaged actively in his research up to the time of his death.

AN OBSERVATION OF *LAEVICARDIUM MORTONI* ACTUALLY SWIMMING.—On June 1, 1963, while collecting the ectoparasitic gastropod, *Odostomia bisuturalis* (Say, 1821), on its host the common oyster, *Crassostrea virginica* (Gmelin, 1790), we witnessed an unusual phenomenon in the behavior of a pelecypod. This happening was so unusual that it might have gone unreported for lack of confirmation had only one of us observed the occurrence. We were wading side-by-side in shallow water when we observed what appeared to be a 'tadpole' swimming. Leaning forward, we saw *Laevicardium mortoni* (Conrad, 1830), its foot extended well beyond the ventral edge of the shell and moving in a sculling motion, in this way propelling the shell through the water. In a few moments the animal withdrew its foot and fell to the bottom where it remained on its side. It was then that we identified the species. This observation was made several hundred feet in from the mouth of Bass River, a river which separates the towns of West Dennis and Yarmouth, Massachusetts, on Cape Cod. The tide was ebbing, the water was 3-6 inches deep, clear, with no ripples to distort the observation. Edward S. Morse (Proc. Bos. Soc. Nat. Hist. 35 (5): 173, 1919) illustrated the extended foot of *L. mortoni* and remarked that, "The foot is long, white and pointed and active in its movements." Morse also mentioned that this animal was able to push itself about with the aid of its foot but so far as we know ours is the first observation of actual swimming movements in this bivalve.—EMMETT B. BAKER, Kingston, Massachusetts, and ARTHUR S. MERRILL, Woods Hole, Massachusetts.

CORBULA LIMATULA AGAIN. — *C. limatula* Conrad, between Feb. and June, 1846, Proc. Acad. Nat. Sci. Philadelphia 3 (1): 25, pl. 1, fig. 2, was discussed briefly in 1964, Naut. 78: 69. It evidently does not belong in the same group¹ as *C. (Caryocorbula) contracta*

¹ The prior name for the subgenus (or genus?) is *Bothrocorbula* Gabb, 1873.

Say, which is more nearly equivalve, both in sculpture and size, although the 2 species were associated by Lamy, 1941, J. de Conch. 84: 228. It actually appears to belong in *Varicorbula*, which is uncomfortably close to *Corbula* s. s., type *C. sulcata* (Lamarck) from west Africa; both are decidedly inequivalve in sculpture and usually also in size. *C. limatula* seems closest to *C. operculata* Philippi, 1848, Zeitschr. Malak. 5: 13. This last often has been considered a synonym of *C. disparilis* Orbigny in Sagra, Hist. Cuba, Moll. 2: 283 (322 of Spanish ed.), pl. 27, figs. 1-4, the date of which is highly dubious (either text or plate), and may be as late as 1853.

[In both French and Spanish editions, the headings of plates 26 to 28 are in larger type than those preceding them. In the Spanish text, almost all Orbigny's names are followed by "(d'Orb., 1846)" which must be a manuscript date, in signatures 61 to 93 (pp. 241 to 371). In the French edition, the same (without the parentheses) is true of signatures 10 to 23 (pp. 145 to 368) with the exception of *Purpura galea* (p. 147, "1846") which is in signature 60 (p. 239) of the Spanish one. None of Orbigny's *Corbula* spp. is quoted in C. B. Adams, 1852.]

Orbigny stated that *C. disparilis* was inequivalve, but his figs. 1-3 show valves almost equal in size and relatively higher than in *C. limatula*, or *operculata*, although similarly different in sculpture. I doubt if *disparilis* be conspecific with the other 2. However, if these 3 names be considered synonyms, *C. limatula* appears to be the prior name for this species of the group *Varicorbula*. — H. BURRINGTON BAKER.

ANISORHYNCUS VS. URSIRIVUS. — Because *Anisorhynchus* Conrad, 1874, Proc. Acad. Nat. Sci. Philadelphia 26: 27, 28, originally was used in 3 places (and subsequently quoted by Gabb), it can not be considered an "error" for *Anisorhynchus* "Conrad" Meek in Hayden, 1871 (a homonym). Also in the same paper (p. 27), Conrad discussed the difference between *Pachydon* and its emendation *Pachyodon* (another homonym). In fact, he included in *Anisorhynchus*, with certainty, only one species, his *Pachydon cuneiformis*, although he stated "it is closely related to *A. pyriiformis*, Meek." Apparently, *Ursirivus* Vokes, 1945, Bul. Amer. Mus. Nat. Hist. 86: 15, was an unnecessary substitute.—H. B. B.

CORBICULA MANILLENSIS IN THE ALABAMA RIVER. — On Sept. 6, 1964 two small specimens of *Corbicula manillensis* Philippi were collected in the Alabama River at Claiborne, Monroe County, Alabama. — LESLIE HUBRIGHT.

EUPERA SINGLEYI IN OKLAHOMA.—On October 20, 1964, *Eupera singleyi* (Pilsbry) was found abundant attached to the undersides of waterlogged wood in Little River, in the rapids below the US-70 bridge, northeast of Idabel, McCurtain County, Oklahoma. This species had not been reported previously from Oklahoma. — LESLIE HUBRIGHT.

CASSIS MADAGASCARIENSIS SPINELLA OFF NORTH CAROLINA COAST. — Abbott in "American Seashells" (1955, see pp. 194) lists *Cassis madagascariensis spinella* Clench as occurring "Off Beaufort, North Carolina (fossil?), and the Florida Keys." On April 15, 1963 two specimens of this subspecies were taken from a shrimp trawler unloading at Morehead City, North Carolina by a Mr. Stephen Brown. These specimens had been taken alive off Cape Lookout, North Carolina. The smaller of the two, donated to the mollusk collection of the University of North Carolina, Institute of Fisheries Research, was catalogued as number 1131. Data for it is as follows: length, 186 mm.; width, 131; number of whorls, 9; number of spines on first tubercle row of body whorl, 12; number of teeth on inner margin of outer lip, 11; operculum length, 48 mm.; and operculum width, 8 mm. These and other characteristics fit the description for the subspecies as first described by Clench in "Johnsonia" (1944, 1[16]: 15-16). Helmet shells are found not uncommonly off the North Carolina coast, particularly in the Cape Lookout and Cape Hatteras areas. Several different forms may be present and many of the shells found are fossil. The above record provides the first evidence that a living population of the Helmet Shell, *C. m. spinella* occurs as far north as Cape Lookout, North Carolina.—HUGH J. PORTER, University of North Carolina, Institute of Fisheries Research, Morehead City, North Carolina.

NOTE ON GASTROCOPTA TAPPANIANA (C. B. Adams). — In 1842 C. B. Adams published this species in Thompson, Z., History of Vermont. No locality was given and subsequent writers have as-

sumed that it came from Vermont, and this has been considered its type locality. In 1942 the Museum of Comparative Zoology received the C. B. Adams collection and the original types of Adams were contained in it. The type locality on the label is Roscoe [Coshocton Co.], Ohio. *G. tappaniana* appears to be a synonym of *G. pentodon* (Say); the lectotype (here selected) is nearest to the figure of *pentodon* given on pl. 3, fig. 7, 1916, Manual of Conch. (2) 24: 33, and not to fig. 9 which is given as *tappaniana*. This same plate was republished in Land Mollusca of North America, vol. 2, pt. 2, fig. 477, p. 887, Mono. no. 3, Acad. Nat. Sci. Philadelphia, 1948. The following is the complete reference:

Pupa tappanianum 'Ward' C. B. Adams 1842 [in] Thompson, Z., History of Vermont (no locality). [Lectotype, here selected, Mus. Comp. Zool. no. 186171; paratype no. 186172, from Roscoe [Coshocton Co.], Ohio]. — WILLIAM J. CLENCH.

BRIEF CENSUS OF LOG-ASSOCIATED SNAILS in Berks County, Pennsylvania. — The present census was done to fulfill the requirements for a research project in the zoology course at Kutztown State College during the summer of 1964. The material has been identified by Dr. Glenn R. Webb, who also attempted to exclude all the non-living specimens from the census. A few seemingly recently-dead and fly-parasitized shells were included with the living shells because it was believed probable that they were alive a few weeks before being collected.

The study consisted of collecting all the snails on or under part of the logs in a wood-lot on the Lehigh-Berks County line, 1½ miles south of Alburtis, Pennsylvania. The 9 logs included had a total area of about 3996 square inches (27.6 square feet). The habitable area of a log was calculated roughly by the formula: Area = length \times width (diameter of log). The areas were doubled in the calculations because specimens were secured both on the log and in the depression where it had lain before being overturned. Less error seemed to result from this formula than from using that for the area of a cylinder. Areas so calculated are rough approximations only.

The results were as follows. The calculated 3996 square inches of log habitat yielded 384 living, dying, and recently dead specimens of *Ventridens suppressus* (Say); two immature snails tenta-

tively identified as *Mesodon inflectus* (Say); one *Retinella indentata* (Say); and one specimen of *Helicodiscus parallelus* (Say). The average number of *V. suppressus* was .09 per square inch or one per 10.4 square inches of log habitat. — WILLIAM W. MOYER, Kutztown State Coll., Kutztown, Pa.

COLLECTIONS DEPOSITED. — Both the mussel collection of Dr. Harold Ray Eggleston of Marietta College, Marietta, Ohio, and the snail collection of Dr. David T. Jones, 818 East 5th Street, Vinton, Iowa, have been deposited recently in the Ohio State Museum, Columbus 10, Ohio, where Dr. David H. Stansbery is Curator of Natural History. — DAVID T. JONES.

CORRECTION. — New Land Mollusks in the Families Camaeniidae and Fruticicolidae from Hispaniola. Museo Argentino de Ciencias Naturales "Bernardino Rivadavia" 8: 213-227, Dec. 1962. Unfortunately, neither galley proofs nor page proofs of this paper of mine were ever received for corrections. The two plates were interchanged. The caption for plate 1 is for plate 2 and the caption for plate 2 is for plate 1. — W. J. CLENCH

CORBULA CUNEATA AND C. INAEQUALIS. — In his descriptions of these, Say, 1824, J. Acad. Nat. Sci. Philadelphia 4: 152 & 153, pl. 13, figs. 3 & 2, cited fig. 3 for both species. In his "reprint," Harris, 1896, Bul. Amer. Paleont. no. 5: 76, made matters worse when he gave fig. 2 for *cuneata* and fig. 3 for *inaequale* (sic). Both Say's dimensions ("breadth" = length & "length" = height) and his descriptions prove that *C. cuneata* (actually fig. 3) is more elongate than *C. inaequalis* (actually fig. 2). However, the citations (& figs.) in Clark, Shattuck & Dall, 1902, Md. Geol. Surv., Miocene: 281 & 282, are correct.—H. B. B.

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ECOLOGIC IMPLICATIONS OF LIVING PELECYPODS WITH CALCAREOUS SPINES

By DAVID NICOL

Department of Geology, Southern Illinois University, Carbondale, Illinois

This general study is a natural outgrowth of my work on antarctic pelecypods and my interest in cold-water pelecypod faunas because I noted no living spinose pelecypods from arctic (Nicol, 1955, p. 116) and antarctic waters. The main objective of this work is to summarize the data on the spinose Pelecypoda so that they may be useful to the paleoecologist.

The greatest difficulty in a study of this kind is to make a clear-cut definition of a spine. Commonly a spine is thought to end in a sharp point, and many spines of pelecypods do; but some projections on pelecypod shells that do not have pointed ends can be considered spines in the broad sense. Another problem is what is a short spine and what is a long spine. In this case it is important to attempt to set some limit of length between short and long spines because of the relationship of length of spines to water temperature. I am arbitrarily setting the uppermost limit in length for short spines as 10 mm., and any spine longer than this is considered to be a long spine.

In discussing the families with spinose representatives, I shall follow the systematic sequence in Thiele's Handbuch except that I shall discuss the fresh-water pelecypods last. The data are taken from an examination of the pelecypods in the general systematic collection in the Division of Mollusks at the U. S. National Museum. If a certain family is not mentioned, this means that no spinose pelecypods were noted in that group. However, in many cases I do state that I found no spinose specimens in certain major groups. One of the reasons for doing so is that it appears that genetic factors are most surely involved, as well as environmental factors, as to whether a major group will have no spines, short spines, or long spines on the exterior of the shell.

Neither the Protobranchia vera nor the solemyacids have any spinose representatives. This appears to be the condition, too,

in all the arcaceans, including the glycymeridids and limopsids. The mytilids and isognomonids are also non-spinose.

Some of the pteriids have short spines, but in most cases they are outgrowths of periostracum which surround some calcareous material. All spinose specimens noted in this family were taken from warm water.

Most of the species of Pinnidae are spinose, but the spines are never long and are found mainly on the part of the shell that extends above the substrate when the animal is in its normal habitat. Most pinnid species are tropical but a few range into cooler waters such as South Africa, Tasmania, Patagonia, and New Zealand.

Most species of plicatulids have short spines. The species of this family are confined to warm water today. A few species of the large family Pectinidae have short spines. Most of these species are found in warm water, but a specimen of *Chlamys pusio* from southern England has short spines and the same is true for a specimen of *Hinnites multirugosus* from the Gulf of Alaska. Many species of *Spondylus* have long spines, and this family today is confined almost entirely to warm water. Specimens with the longest slender spines are generally found in the warmest waters such as in the Philippines and Borneo. Spines as long as 25 mm. are not uncommon on specimens of the Spondylidae. Some species of limids have short spines. All limid specimens with spines in the U. S. National Museum collection were taken from warm water. Arctic and antarctic species of *Limatula* are not spinose.

A few specimens of anomiidids have short spines. The most spinose specimen seen was an *Anomia peruviana* from the Gulf of California. In the discussion of *Anomia*, mention must be made of an interesting paper by Merrill (1962) on spinosity in *Anomia aculeata*. Merrill found that some individuals of this species became spinose while others never developed spines. He points out (p. 137) that the variation in surface sculpture might be a genetic factor rather than an environmental factor. In this case where spinose and non-spinose forms were taken from the same buoy, the genetic factor must be the decisive one. Living species of *Arclinella* [*Echinochama*], a warm-water pelecypod, are always spinose, but the warm-water *Arca* species are never spinose. Both groups live on the bottom and have all the environmental factors

most favorable for the production of spines; and so one must conclude that genetics as well as environment is an important factor in determining the presence or absence of spines. It should be pointed out that species of pelecypods which have both spinose and non-spinose variants are more numerous than those living species which have only spinose representatives.

Merrill also notes that the small shells are never spinose but that spinosity becomes common after a certain size is attained. However, some species of pelecypods tend to lose their spines when they attain large size, as seen in some individuals of chamids and spondylids.

Many species of ostreids are spinose. Short-spined species range into cool water, as for example *Crassostrea virginica*, which ranges as far north as the Gulf of St. Lawrence. It should also be noted that this species lives in water of reduced salinity. Dr. Joseph Rosewater showed me a small oyster (15 mm. in height) that he collected off mangrove roots in the Strait of Malacca. It has short slender spines on the surface of the upper valve. Long-spined ostreid species are all tropical, and species like *Ostrea frons*, in which the spines wrap around the stems or roots of trees, are confined to warm water. Species of *Arctostrea* from the Cretaceous are similar to *Ostrea frons* in their elongate shape and type of spinosity.

Living trioniids, which are confined to Australian waters, are sometimes found to have tiny spines. The astartids and crassatellids are all non-spinose. A few carditid species having short spines were found in tropical waters but one specimen came from South Australia. Nearly all of the lucinids are non-spinose, but several specimens of *Lucina pensylvanica* from the Florida Keys have short spines. *Lucinoma dentifera* from the Red Sea also has short spines.

The chamids rival the spondylids for being the most spinose family of pelecypods, and most species of chamids have spinose representatives. The family is almost completely confined to warm water, but a few species straggle into cooler waters. Specimens of *Chama pellucida* from Newport Beach, California, and San Pedro, California, do have broad flat spines that are 12 mm. in a few cases. This species ranges as far north as Oregon. *Chama macerophylla* from Miami, Florida, has long spines, and *Chama*

lazarus from the East Indian region commonly has spines of more than 20 mm. in length. *Arcinella*, also known as *Echinochama*, is the most spinose of all living chamids. The genus is confined to warm water of the western hemisphere and shows a good gradient between temperature and spine length. The longest and usually most slender spines are found on *Arcinella arcinella arcinella* from the Caribbean region and *Arcinella arcinella californica* from the Panamic Province. *Arcinella brasiliensis* from the southernmost range of the genus in the western Atlantic has slender spines, but they are shorter than those commonly found on *Arcinella arcinella*. *Arcinella cornuta*, which ranges as far north as Cape Hatteras, has shorter and thicker spines than *Arcinella arcinella*.

Numerous species of the cardiids have short spines. Probably the most spinose group is *Acanthocardia*, and some species of this genus are found in cooler waters. *Acanthocardia aculeata* from the south coast of Devon has surprisingly long slender spines, but no specimens were observed with spines as long as 10 mm. Arctic cardiid species lack spines. *Hippipus* has short spines and a color pattern resembling the spines and color pattern of the cardiids. The remainder of the living tridacnids are either smooth or have broad projecting frills rather than spines.

The great majority of venerids are not spinose, but a few tropical species have short spines. One exceptional group, *Pitar* (*Hysteroconcha*), has one or two rows of long slender spines toward the posterior side of the shell; this subgenus is confined to the warm waters of the Caribbean region and the Panamic Province. The well developed pallial sinus would indicate that these forms are reasonably deep burrowers, but it is difficult to understand how the spines would be an aid in burrowing.

The mactrids, donacids, gariids, and semelids are all non-spinose. Few species of tellinids have short spines, and they are all tropical forms. The solenids are also non-spinose, as well as the hiatellids, corbulids, myacids, and gastrochaenids. Most of the pholadids have short spines which may aid these animals to bore in rock. The families Teredinidae, Lyonsiidae, Pandoridae, Chamostreidae, Myochamidae, Laternulidae, and Periplomatidae are all without spines. *Brechites*, a warm-water clavagellid, has short spines.

The Septibranchia are essentially non-spinose, although speci-

mens of *Euciroa* from Borneo might be considered spiny by some observers. The spines on *Euciroa* are certainly minute.

Some specimens of *Canthyria collina* have short spines. Commonly there are only one or two present, and they are located just to the posterior of the center of the shell. This species is confined to the James River, Virginia, and the Tar River in North Carolina. Another naiad, *Canthyria spinosa* from the Altamaha River, Georgia, has long slender spines. The spines are located near the posterior side and are hollow in the center; they commonly attain a length of 20 mm. Some specimens of this species have no spines or spines on only one valve. A variety of *Schistodesmus lampreyanus* from near Shanghai, China, apparently has short spines, but there are no specimens of this variety in the U. S. National Museum collection. One more naiad should be mentioned: *Chelidonopsis hirundo* from the Congo region has a posterior flange on each valve that slightly resembles a spine. The Corbiculidae and Sphaeriidae all lack spines.

The great majority of spinose species of pelecypods are members of the epifauna. Such species are most numerous in warm sea water and become much less so in the colder waters. As examples of the epifaunal groups, one can list the pteriids, plicatulids, pectinids, spondylids, chamids, most if not all the tridacnids, limids, anomiid, and ostreids; and I would even include the pinids in this category because, although they do partially bury themselves in the bottom, they remain attached by a byssus in a fixed position during the adult part of their life. The infauna has relatively few spinose representatives, the most startling ones being the few species of tropical venerids with long spines and one long-spined naiad from the Altamaha River in Georgia. Most active burrowers in soft substrate have either small spines or none at all. Note, too, that the protobranchs and septibranchs which are mainly burrowers are all non-spinose. Many of the pholadids which bore into rock do have short spines, and these may assist them in their cutting into the hard substrate.

No long-spined species are found in brackish water, and short-spined forms are less common in an environment of reduced salinity than they are in normal water. The fresh-water pelecypods are almost never truly spinose; only three spinose forms of living naiades are known to occur in limited geographic re-

gions. It is true that the naiades are commonly noded or knobby exteriorly but not truly spinose.

The reader has probably already noted that families and genera which have shells of small maximum size never develop calcareous spines. Examples of such groups are *Mysella*, *Philobrya*, *Cyamium*, *Cyamiomactra*, *Montacuta*, *Crenella*, and *Dacrydium*. The species of these genera rarely attain a maximum size of more than 10 mm., and they are commonly smaller than that. It is also noted that these genera are most abundantly represented in cold sea water or deep sea water. Small species attached by their byssuses to other living animals as commensals also do not develop spines.

Arctic and antarctic pelecypods are devoid of spines. The surface temperature of the sea water in these polar regions certainly never reaches a maximum of more than 5° C. It is possible that short-spined pelecypods may live in water that never becomes much more than 5° C, but it is more likely that 10° C is the lowest maximum temperature where one would find any spinose pelecypods (e.g., August surface temperature in the Gulf of Alaska). Long-spined forms are not found in areas where the minimum water temperature falls below 20° C, and long slender spines are found in areas where the minimum water temperature is at least 25° C (e.g., *Arcinella arcinella*). Thus, the long-spined pelecypods are generally limited to about the temperature where one would expect to find any reef corals. Finally, oysters that have the habit of clasping slender objects such as twigs with their spines (e.g., *Ostrea frons*) also are confined to water that never reaches a lower temperature than about 20° C.

Water depths, temperatures, and other ecologic data are generally inadequate concerning the pelecypod material in the U.S. National Museum collections, and so it is not possible to reach precise conclusions concerning the occurrences of spinosity in deep-water (more than 1,829 meters) pelecypods. Clarke (1962b, p. 295) notes that only a few mollusk genera show sculpturing, and he names two gastropod genera as those that exhibit this feature. Some of the families and genera cited in Clarke's annotated list (1962a) of abyssal pelecypods are represented by a large number of species in this fauna. Where these same families and genera also occur in shallow water, they are mainly non-spinose. The deep-water fauna includes an unusually large number of proto-

branches and septibranchs. If there are any spinose deep-water pelecypods, they must all be short-spined forms.

These data concerning spinosity in living pelecypods can lead to inferences concerning the ecology of most Tertiary pelecypod faunas, I would think, with a considerable degree of confidence; but what of older faunas and other groups of calcareous spined organisms? For example, in the Middle Devonian Misenheimer Shale in southern Illinois, a small productoid brachiopod with long needle-like spines is found. Is this a good indicator of warm water during the deposition of the Misenheimer Shale?

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NOMENCLATURE NOTE ON *ARCINELLA* VERSUS *ECHINOCHAMA*

A. Myra Keen (1962, p. 179) pointed out that because the International Commission on Zoological Nomenclature in 1956 rejected Oken's *Lehrbuch der Naturgeschichte*, vol. 3 (Zoology) the generic names in this work no longer have official status in zoological nomenclature unless properly validated after the work was published (1815-1816). Oken proposed the name *Arcinella* for a carditid group in his *Lehrbuch*. In 1817, Schumacher proposed the name *Arcinella* for *Chama arcinella* Linne, which is also the type species of Fischer's genus *Echinochama* (1887). Miss Keen concludes that *Arcinella* of Schumacher is now available as the generic name for the species *Chama arcinella* Linne and also *Echinochama californica* Dall. I have no objection to using the generic name *Arcinella* for these species, but I am afraid that some malacologists will object sooner or later. These objectors will point to the latest International Code of Zoological Nomenclature and say that *Arcinella* of Schumacher is to be considered a forgotten name (nomen oblitum). Furthermore, they can probably win this particular case. For example, I looked for the name *Arcinella* in the Zoological Record for the years 1900-1960 and found it listed only 3 times. In no case did I see it used for what we heretofore have been calling *Echinochama*. I do not consider this conclusive proof that *Arcinella* has not been used as a generic name in the sense of *Echinochama*, but some malacologists might regard this as enough evidence to consider *Arcinella* of Schu-

macher a nomen oblitum. My personal preference is to apply strict priority in such a case where the genus is relatively unimportant and has few species. *Echinochama* has not been mentioned frequently in primary zoological literature within the past 50 years. I fail to see that a name change in such a small unimportant genus should be upsetting. (On the other hand, I certainly would be in favor of invoking the "nomen oblitum" rule in the case of *Ostrea*.) Furthermore, one ruling by the Commission so often brings on one or more additional nomenclature problems as the direct result of a decision by the International Commission. This very case is an example of that.

If someone has not already done so, it will be only a matter of time before some well-meaning person asks the International Commission for a ruling in favor of retaining the name *Echinochama*. However, the writer of this paper has no intention of taking such action.

LITERATURE CITED

- Clarke, Arthur H., Jr., 1962a, Annotated list and bibliography of the abyssal marine molluscs of the world: Nat. Mus. Canada Bull. no. 181, 114 pp.
- , 1962b, On the composition, zoogeography, origin and age of the deep-sea mollusk fauna: Deep-sea Res. and Oceanographic Abs. 9:291-306, Pergamon Press, London.
- Keen, A. Myra, 1962, Nomenclatural notes on some West American mollusks, with proposal of a new species name. Veliger 4, (4):178-180.
- Merrill, Arthur S., 1962, Variation and change in *Anomia aculeata*. Nautilus 75 (4):131-138, pl. 14.
- Nicol, David, 1955, An analysis of the Arctic marine pelecypod fauna. Nautilus 68 (4):115-122.
- Thiele, J., 1934, Handbuch der Systematischen Weichtierkunde, Bd. 2, T. 3, pp. 779-1022, Gustav Fischer, Jena.

NEW MOLLUSCAN RECORDS FOR THE GALAPAGOS ISLANDS

BY WILLIAM K. EMERSON AND WILLIAM E. OLD, JR.
American Museum of Natural History

During the past three years the American Museum of Natural History has accumulated a small collection of marine mollusks, largely gastropods, from the Galapagos Islands. Most of the

specimens were purchased from Mr. Carmen Angermeyer and Mrs. Jacqueline DeRoy of Academy Bay, Santa Cruz Island. Their material was collected in the intertidal zone and by dredging from a skiff in depths of 4 to 15 fathoms.

The 11 species of gastropods prefaced by an asterisk (*) in the discussions that follow appear to be new records for the Galapagos molluscan fauna, which is composed largely of species of the Panamic faunal province, together with small elements of Indo-Pacific and endemic species. These records represent eight Panamic and three Indo-Pacific species. The distribution of these species in the eastern Pacific, including occurrences on the off-shore islands: Revillagigedo Islands (Clarion and Socorro), Cocos Island, and the oceanic atoll: Clipperton Island, is cited. The literature pertaining to the recent marine mollusks of the Galapagos Islands was summarized recently by Hertlein and Strong (1955a).

Architectonicidae: **Heliacus bicanaliculatus* (Valenciennes), 1832, synonym: *H. radiatus* (Menke), 1851. Mrs. Angermeyer reports taking two beach specimens, one of which is in the present collection, from Academy Bay, Santa Cruz Island. This Panamic species previously was reported to range on the mainland from Punta Penasco, Sonora, Mexico (Lowe, 1935), to Bahía Honda, Veragua, Panama (Strong and Hertlein, 1939); it is recorded from Clarion Island and Socorro Island (Strong and Hanna, 1930).

Cypraeidae: **Cypraea teres* Gmelin, 1791. Mrs. Angermeyer collected one beach specimen at Puerto Grande, San Salvador Island, and she reports that a second beach specimen was taken by a neighbor. The only previously known occurrence of this Indo-Pacific species in the eastern Pacific was at Clipperton Island, where fresh as well as worn specimens are reported from the rocky beaches (Hertlein, 1937; Hertlein and Allison, 1960a). Another Indo-Pacific species, *Cypraea moneta* Linnaeus, 1758 and 5 of the 7 recent Panamic *Cypraea*, namely *albuginosa* Gray, 1825, *isabellamexicana* Stearns, 1893, *cervinetta* Kiener, 1843, *arabacula* Lamarck, 1811, and *nigropunctata* Gray, 1828, also are known from the Galapagos Islands (Ingram, 1948). Additionally, *Cypraea darwini* Ingram, 1948, was described from "old beach deposits" [? Pleistocene] on Baltra del Sur [South Seymour Island] and was based on a single specimen, which, judging from

the description and illustrations appears to be a form of *C. albuginosa*. It is interesting to note that only two west American species, *C. albuginosa* and *C. isabellamexicana*, are known to occur at Clipperton Island, where 10 Indo-Pacific species of *Cypraea* are recorded (Hertlein and Allison, 1960a). Also of interest is the presence at Cocos Island of *C. albuginosa* (Emerson and Old, 1964), *C. isabellamexicana*, *C. moneta*, and *C. rashleighana* Melvill, 1888, which is the sole record for this Indo-Pacific species in the eastern Pacific (Ingram, 1951). Only *C. albuginosa* and *C. isabellamexicana* are reported from the Revillagigedo Islands (Ingram, 1951).

Ovulidae [= Amphiperatidae auct.]: **Pseudocypraea adamsoni* (Sowerby), 1832. Mrs. Angermeyer reports taking four living specimens under rocks at low tide and one beach specimen at Academy Bay, Santa Cruz Island. Two of the specimens are in the present collection, and these appear to be referable to this Indo-Pacific species, which is recorded to range from Madagascar to the Tuamotu Islands (Schilder, 1932). According to Schilder (1947), this species does not occur in the Hawaiian Islands; he cites it, however, from several other localities in the western Pacific, including Japan (1947), New Britain (1933) and Jaluit, Marshall Islands (1944).

Cassididae: **Semicassis centiquadrata* (Valenciennes), 1832. Mrs. Angermeyer obtained one beach specimen from Rábida Island. This Panamic species, which is reported to range on the mainland from Baja California, Mexico, to Lobitos, Peru (Emerson and Old, 1963), also is cited from Clarion Island (Strong and Hanna, 1930) and Cocos Island (Emerson and Old, 1964). All the living west American representatives of this family, with the exception of *Casmaria vibexmexicana* (Stearns), 1894, now are known to occur in the Galapagos Islands.

Cymatiidae: **Cymatium gibbosum* (Broderip), 1833. Mrs. Angermeyer reports finding one living specimen and one large beach specimen, which is in the American Museum collection, from Academy Bay, Santa Cruz Island. This Panamic species is known to range on the mainland from the Gulf of California, Mexico, to Negritos, Peru (Emerson and Old, 1963).

Bursidae: **Bursa caelata* (Broderip), 1833. Mrs. Angermeyer reports taking 3 beach specimens, one of which is in the present

collection, from Academy Bay, Santa Cruz Island. This Panamic species is recorded to range on the mainland from Baja California, Mexico, to Peru (Hertlein and Strong, 1955b), and is cited from Cocos Island (Hertlein, 1963).

Muricidae: **Favartia incisa* (Broderip), 1833. Mrs. Angermeyer obtained 3 specimens, one of which is in the present collection, by dredging in 10 fathoms off Rábida Island. Keen (1958) reports this Panamic species to range from Port Guatulco, Mexico, to southern Ecuador. **Ocenebra vittata* (Broderip), 1833. One beach specimen was received from Mrs. DeRoy from Academy Bay, Santa Cruz Island. Mr. Anthony D'Attilio has obtained from Mrs. Angermeyer 7 other specimens from the following localities: Puerto Nunes and Academy Bay, Santa Cruz Island; Rábida Island; San Salvador Island; shore to 8 fathoms. Keen (1958) reports this Panamic species to range from the Gulf of California, to Guayaquil, Ecuador. **Thais biserialis* (Blainville), 1832, synonym: *T. haematura* (Valenciennes), 1846. Mrs. Angermeyer reports taking 3 specimens from Rábida Island. One large beach specimen in the present collection is a typical example of this Panamic species, which is reported to range on the mainland from Baja California, Mexico, to Valparaiso, Chile (Clench, 1947). It also is cited from Cocos Island (Hertlein, 1963) and Clipperton Island (Hertlein and Allison, 1960b).

Coralliophilidae [Magilidae]: **Coralliophila violacea* (Kiener), 1835, synonym: *C. neritoidea* (Lamarck), 1822. One live-collected specimen from Academy Bay, Santa Cruz Island was received from Mrs. DeRoy. This wide-ranging Indo-Pacific species was previously known in the eastern Pacific only from Clarion Island, Socorro Island (Strong and Hanna, 1930), and Clipperton Island (Hertlein and Allison, 1960b). **Latiaxis hindsii* (Carpenter), 1857, synonym: *L. muricata* (Hinds), 1843. One live-taken specimen was dredged by Mrs. Angermeyer in 1.5 fathoms off Rábida Island. This species was previously cited from the Galapagos Islands under the name of *Coralliophila oldroydi* (Oldroyd, 1929). This Panamic species is reported to range on the mainland from Puertecitos, Baja California, Mexico (DuShane, 1962), to Panama (Carpenter, 1857).

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LITERATURE CITED

- Carpenter, P. P. 1857. Rept. Brit. Assoc. Adv. Sci. for 1856, pp. 159-368.
- Clench, W. J. 1947. *Johnsonia* 2 (23):61-91, pls. 33-40.
- DuShane, Helen. 1958. *Veliger* 5:39-50.
- Emerson, W. K., and W. E. Old, Jr. 1963. *Amer. Mus. Novitates*, no. 2153, 38 pp., 28 figs.
- Emerson, W. K., and W. E. Old, Jr. 1964. *Nautilus* 77:90-92.
- Hertlein, L. G. 1937. *Proc. Amer. Philos. Soc.* 78:303-312, pl. 1.
- , 1963. *Proc. Calif. Acad. Sci.* (4) 32:219-289, 4 figs.
- , and E. C. Allison, 1960a, *Veliger* 2:94-95, pl. 22.
- , and E. C. Allison, 1960b, *Ibid.* 3:13-16.
- , and A. M. Strong, 1955a, in *Essays in the Natural Sciences in Honor of Captain Allan Hancock*, Univ. So. Calif. Press, Los Angeles, pp. 111-145, pl. A.
- , and A. M. Strong, 1955b, *Bull. Amer. Mus. Nat. Hist.* 107:159-318, pls. 1-3.
- Ingram, W. M. 1948. *Proc. Calif. Acad. Sci.* (4) 26:135-145, pl. 2.
- , 1951. *Bull. Amer. Paleont.* 33:125-178, pls. 21-24.
- Keen, A. Myra. 1958. *Sea shells of tropical west America*. Stanford Univ. Press, viii + 624 pp., illus.
- Lowe, H. N., 1935, *Trans. San Diego Soc. Nat. Hist.* 8:15-34, pls. 1-4.
- Oldroyd, Ida S. 1929. *Nautilus* 42:98, 99, pl. 5.
- Schilder, F. A. 1932. *Cypraeacea*, in Quenstedt, W., *Fossilium Catalogus*, 1: Animalia, Berlin, pt. 55, 276 pp.
- , 1933. *Zool. Anz.* 102:288-303, 12 figs.
- , 1947. *Arch. Moll.* 76:169-189.
- , and M. Schilder. 1944. *Arkiv för Zoologi*, 36 A:1-32.
- Strong, A. M. and G. D. Hanna. 1930. *Proc. Calif. Acad. Sci.*, (4) 19:7-12.
- Strong, A. M. and L. G. Hertlein. 1939. *Allan Hancock Pac. Exped.* 2:177-245, pls. 18-23.

ON SOME LAND SHELLS OF ELEUTHERA, BAHAMAS

BY MORRIS K. JACOBSON

Associate, American Museum of Natural History

This report is based upon a small collection of land shells made by Mr. and Mrs. Norman Jensen of the New York Shell Club in July, 1964. The shells were all taken dead in underbrush near or under calcareous rocks. This collection is of some interest because it adds two new localities to those mentioned by

Clench (p. 101-116), who has made the most complete listing of Eleuthera shells to date. In addition, *Succinea luteola floridana* is reported from the island for the first time. Clench (op. cit.) gives a synonymy of the various species.

To the localities mapped by Clench (pl. 16), the following should be added: Sweetings Pond, on the west shore, one mile north of Hatchet Bay, between stations 12 and 13 of Clench; Ten Bay, about 10 miles south of Governor's Harbour on the west coast between Palmetto Point (Clench, locality no. 21) and Bullards (Clench, locality no. 24).

Alcadia fallax Wagner. Ten Bay, 2 weathered specimens. Clench cites this species from Tarpum Bay in the south and James Cistern in the north. Ten Bay lies about midway between these two points.

Opisthosiphon bahamense (Pfeiffer). Ten Bay, on main road, 4 specimens; Sweetings Pond, 14 specimens. Clench cites 11 localities for this species. There seems to be no reason to reject Clench's evaluation of the Bartsch names (p. 102).

Melampus coffeus (Linné). Ten Bay, two specimens. This is the first localized record; Clench cites it only from "Eleuthera." One small specimen resembles *M. lineatus* Say closely. Probably a similar one caused Dall to report the species from Egg Island, Bahamas (Clench, p. 102).

Detracia bulloides (Montagu). Ten Bay, 4 specimens. The locality closest to the present one mentioned by Clench is Tarpum Bay, far to the south.

Oleacina solidula (Pfeiffer). Ten Bay, 1 specimen; Sweetings Pond, 1 specimen. Clench cites this from 9 localities, reaching from the south to the north of the island. It is apparently well distributed everywhere.

Polygyra plana (Dunker). Ten Bay, 5 specimens. Palmetto Point is the locality cited by Clench which is nearest to the present one.

Bulimulus sepulcralis (Poey). Ten Bay, 1 fresh, mature specimen. This is the first localized record for Eleuthera. Clench cites only "Eleuthera" on the basis of specimens in the Bland Collection. Pilsbry (1897, p. 50) thinks that the home of this species is Yucatan and Central America from where it was introduced into Eleuthera probably by commerce some time after the Spanish conquest.

Cerion glans Küster. Sweetings Pond, 3 specimens, one very small. The variable shells of *Cerion* are not always easily determined, and intergrades are not uncommon. Clench, with some hesitation, cites 13 species from Eleuthera. Determination of the present specimens was made by comparison with shells in the author's collection determined by Clench. The present shells were all collected dead and hence do not necessarily live in the areas collected. Dead *Cerion* shells are quite buoyant and easily transported by wave action from beach to beach. Nevertheless, the localities for the present specimens are not too far removed from the localities cited by Clench.

Cerion glans coryi Maynard. Ten Bay, on main road, 1 specimen which is doubtfully assigned to this form. Clench cites it from 7 localities, reaching from The Bluff in the north to Bannermantown in the south. The present locality is about in the center of the island.

Cerion liliorum Clench. Sweetings Pond, 1 specimen. The assignment is doubtful because the present specimen is about one-half the size of typical *liliorum*. Nevertheless, it conforms in surface sculpture, color, and apertural characteristics. Clench cites it from Long Pond, the locality nearest to the present one.

Cerion eximeum Maynard. Ten Bay, 2 specimens. The present shells have only faint signs of the close surface striation characteristic of this highly variable species.

Microceramus russelli Clench. Sweeting Pond, 1 specimen. Clench cites only 3 localities for this species, of which Hatchet Bay is the closest to the present one.

Succinea luteola floridana Pilsbry. Sweetings Pond, 3 specimens. This is the first *Succinea* cited from the island. The specimens conform closely to specimens collected in Key West, Florida and elsewhere. It is without doubt a very recent introduction. The only other *Succinea* cited from Bahamas is *S. barbadensis* Guilding, 1828 (not *S. barbadensis* Guilding, Reeve, 1872, Con. Icon., 18, *Succinea*, pl. 7, fig. 46). However, this species, though similar in outline to *S. luteola floridana* is not easily confused with it. *S. barbadensis* is thinner, lacks the yellow color in the aperture, and does not have the earthy and opaque texture that is characteristic of the subgenus *Calcisuccinea* Pilsbry, 1948, to which the Floridian shell belongs.

Zachrysia provisoria (Pfeiffer). Ten Bay, 3 mature, 4 immature specimens. This species, originally from eastern and central Cuba, has been introduced into many West Indian islands as well as to the Bahamas and the Florida mainland. Bendall (p. 293) reports it from Bahamas as early as 1895, and Bland from New Providence in 1861 (p. 351; table II). The present locality is far to the north of those cited by Clench, and not near any settlement (Ten Bay is still only a projected housing development). However, the Jensens report having seen it "everywhere."

Zachrysia provisoria is separated from *Z. auricoma* Férussac on the basis of the sexual apparatus (see Pilsbry, 1928). In shell characters they are very close. Since all the present shells were taken dead, it can only be assumed that they are as indicated by Clench. In this connection, Pilsbry's statement (1928, p. 583) that *Z. auricoma*, because of its "hard, calcareous epiphragm" it is probably better able to withstand dessication than the other species, is of interest. One would think it is this species, rather than *provisoria* that would survive in the largely arid, unsheltered areas of the Bahamas.

Hemitrochus varians (Menke). Ten Bay, 5 specimens; Sweetings Pond, 8 specimens. Clench cites this from no fewer than 16 localities. That it is found in two more should excite no surprise.

Plagioptycha macrodon utowana Clench. Ten Bay, 5 specimens. This species can be easily distinguished from *P. gregoriana* Dall by being generally smooth and shiny, with wavy radial raised cords appearing only on a few early post-nuclear whorls. Its distribution seems to be confined to the southern half of the island.

Plagioptycha gregoriana (Dall). Sweetings Pond, 6 specimens. As indicated above, the shell is easily determined by the presence of rather strong, wavy radial costae covering the entire shell except the nuclear whorls. It is apparently confined to the northern half of the island.

Discussion. A plotting of localities of the species based on the data provided by Clench and the Jensens leads to a few interesting observations. The discrete distribution of the two related species of *Plagioptycha* is striking: *P. macrodon utowana* occurs in the southern half of the island, from Governor's Harbour to Bannermantown, whereas *P. gregoriana* occurs in the northern

half, from Sweetings Pond to Next Point. The latter is also found in 4 localities on the satellite islands clustered about the northern tip of Eleuthera.

Polygyra plana seems to be clustered about an area south of the mid-point of the island, from Palmetto Point to Rock Sound. But the single off-shore island locality (Current Settlement) would seem to indicate that more collecting activity will discover it in several more situations at least in the northern half. *Cerion eximeum* seems to be confined to the north, but the apparent cluster of localities of *Microceramus russelli* in the north (from Sweetings Pond to Long Pond) is probably due to incomplete collecting efforts. Certainly this must also be true of *Detracia bulloides*, which can be expected to occur in every favorable tidal area.

As was to be expected, *Opisthosiphon bahamense*, *Oleacina solidula* and especially *Hemitrochus varians* have the most general distribution. Possibly many, if not most, of the other species mentioned here and by Clench, with the exception of *Cerion*, will also be found to enjoy the same general distribution. However, the instance of *Plagioptycha* demonstrates that some important exceptions to this situation will also be found. The island, after all, is not small, extending for about 80 miles, and though it is generally less than two miles for most of its length, it contains 166 square miles of territory (Clench, p. 98).

I wish to express my gratitude to Dr. William K. Emerson of the American Museum of Natural History who has read the manuscript and offered valuable suggestions, and especially to Mr. and Mrs. Jensen who gave liberally of their restricted vacation time to hunt, at my urgent suggestion, for land shells in an area where, as Clench found (p. 98), "in the main, land collecting was poor."

The shells mentioned in this report have been deposited in the collection of the American Museum of Natural History, New York.

LITERATURE CITED

- Bendall, Wilfred. 1895, Proc. Mal. Soc. London, 1:292-295.
Bland, Thomas. 1861, Ann. Lyc. Nat. Hist. New York, 7:335-361.
Clench, William J. 1952, Rev. Soc. Mal. Carlos de la Torre, 8:97-116, pls. 14-16.
Pilsbry, Henry A. 1889, Man. Conch., ser. 2, 5:1-339, pls. 1-64.

——, 1897, *Man. Conch.*, ser. 2, 11:1-339, pls. 1-51.

——, 1928, *Proc. Acad. Nat. Sci. Philadelphia*, 80:581-606, pls. 28-30, text figs. 1-19.

MOLLUSCAN FAUNA OF SOME SMALL PONDS IN GRAND TETON NATIONAL PARK

BY DOROTHY E. BEETLE

Curator of Education, Charlotte Children's Nature Museum, Inc.,
Charlotte, North Carolina

In a previous study of the mollusca of Grand Teton National Park I collections were obtained from many small ponds that dot the area. Considerable variation was found in fauna and flora even between adjacent ponds. Ten ponds in the vicinity of Jackson Lake dam were selected for investigation of molluscan variations and for population analysis of the most abundant gastropod in each.

Ecology. Each of the ponds lies in the lodgepole pine forest that has developed upon the moraines dumped by the Pleistocene glaciers. I assumed, therefore, that their origins and ages are similar. They occur at an approximate elevation of 6700 feet. The annual precipitation in the vicinity of Jackson Lake is about 20 inches, three-fourths of which falls as snow. Summer showers during June, July and August are brief and scarcely replenish the ponds, which are subject to greatly fluctuating water levels. Snow and ice may lie late into May, but the ponds can be open from May through September and evaporation rapidly shrinks their volume. The monthly mean temperature in the region varies from 13.6 to 61.3 degrees Fahrenheit. However, the shallow water of the ponds is warm during the short summer, varying between approximately 60 to 82 degrees F. along the margins. The shallowness of the water bodies precludes any thermal stratification.

The largest of the ponds measures 300 by 100 yards. The smallest is scarcely 100 yards long. Maximum depth of the water varies between one and four feet and accumulates mainly by snow melt. Ponds that dry in summer are without water until the following spring and have a snow rather than an ice cover during the winter. The outlines of abandoned channels and partially submerged beaver lodges in three ponds, Moose, Signal Moun-

tain, and Pacific Creek No. 2 attest to more stable water conditions formerly. Pond bottoms are covered with a layer of mud overlying glaciated stones and gravel.

Pacific Creek Pond 2, Arizona Pond No. 2, Pond No. 4 and No. 10 are small ephemeral bodies of water usually dry by mid-August. Colter Bay Pond dries completely in years of deficient precipitation. Moose, Signal Mountain, Pacific Creek No. 1 and Arizona Pond No. 1 receive some underground water and usually retain a few inches of water at their centers. Pond No. 7 is fed by adequate springs and varies least in water level.

To varying degrees the ponds are ringed by or show scattered remnants of aspen stands. Interior to the aspen are willows. Sedges, grasses, forbs and moss grow along the edges of the ponds. By mid-summer the water in most of the ponds is so covered with rooted aquatic plants as to give the appearance of a meadow. *Conium maculatum*, *Sagittaria cuneata*, *Ranunculus cymbalaria*, *Mentha arvensis* and species of *Carex* and *Juncus* are amphibious plants commonly found in the ponds. *Nuphar polysepalum*, the yellow pond lily, was found only in ponds that retained some water if but an inch or two.

THE MOLLUSCAN FAUNA OF SOME PONDS IN GRAND TETON NATIONAL PARK

TABLE 1.	MOOSE	SIGNAL MT.	COLTER BAY	POND #4	PACIFIC CREEK# 1	PACIFIC CREEK #2	POND #7	ARIZONA #1	ARIZONA #2
<i>Sphaerium lacustre ryckholtii</i>	X	X	X	X	X	X		X	
<i>S. partumeium</i>						X		X	
<i>S. striatinum</i>					X				
<i>Pisidium casertanum</i>		X			X	X			X
<i>P. compressum</i>							X		
<i>P. obtusale robusta</i>		X						X	
<i>Valvata lewisi</i>					X	X		X	
<i>Stagnicola jacksonensis</i>			X						
<i>S. palustris</i>				X		X		X	
<i>S. p. wyomingensis</i>	X								
<i>S. caperata</i>						X			
<i>Gyraulus parvus</i>					X				
<i>G. circumstriatus</i>	X				X	X			
<i>Armiger crista</i>					X				
<i>Helisoma subcrenatum</i>					X	X		X	
<i>Planorbula christyi</i>	X			X	X	X			
<i>Promenetus exaequus</i>					X	X		X	
<i>P. umbilicatellus</i>	X		X						
<i>Physa gyrina</i>	X		X					X	
<i>P. skinneri</i>	X					X		X	
<i>Aplexa hypnorum</i>					X	X			

Methods. The molluscan fauna of each pond was collected and identified. The temperature was taken one foot below the surface at each visit, several feet offshore and also along the shore. Four ponds were then selected for population analysis

and at intervals during the three summer months of June, July and August a random sample of approximately 100 individuals of the most abundant species was sized. The four ponds are Moose, Colter Bay, and Pacific Creek No. 1 and No. 2. See Table 1 for the faunal composition of the various ponds.

Discussion. In early June the pond at Colter Bay, Sec. 35, T46N, R115W, extends shallowly into the aspen around its shoreline. Not more than three feet in depth it rapidly shrinks by evaporation. By mid-August the remaining water lies in a small depression along the north boundary. As the water recedes the lavender bloom of *Mentha arvensis* covers the dry pond bed. This pond dried completely in September of 1960 and 1961.

A large population of *Stagnicola jacksonensis* and *Sphaerium lacustre rykholti* frequent Colter Bay pond. In two seasons of study only one live *Promenetus umbilicatellus* and five *Physa*

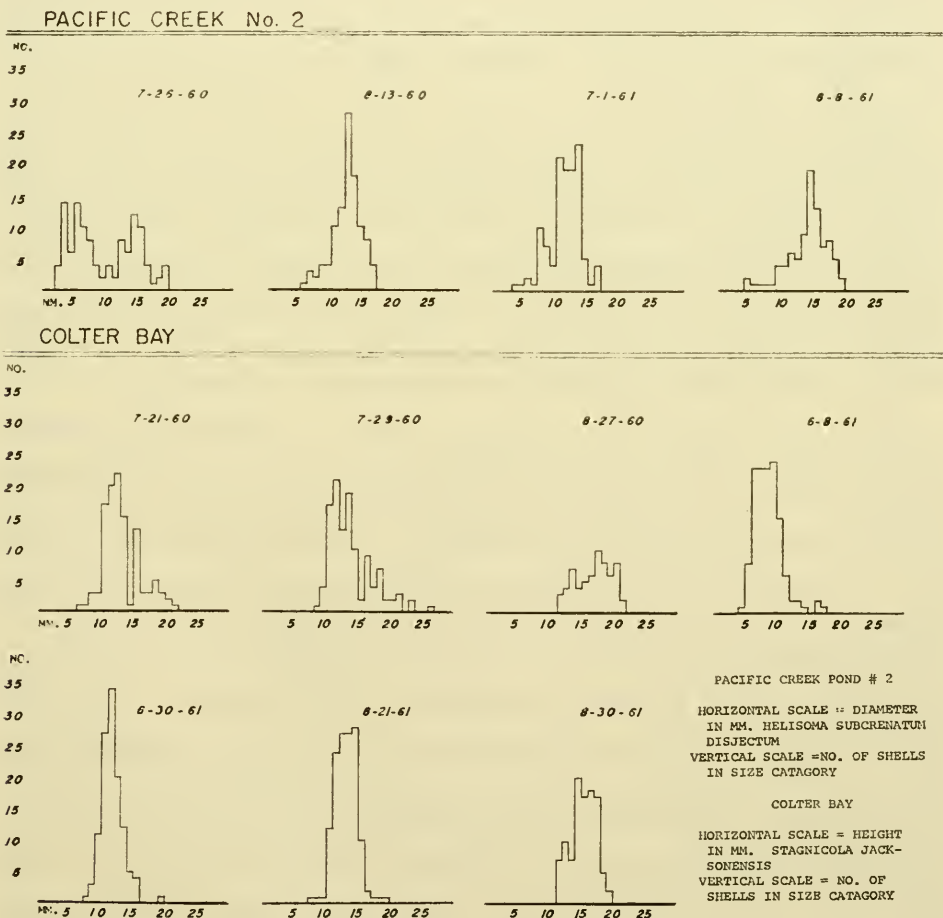


FIGURE I. HISTOGRAMS OF POPULATION SIZE CLASSES IN 2 PONDS DURING 1960-1961.

gyrina were collected. In addition to the mollusks the pond supports an abundant fauna of crustaceans, insects, tiger salamanders, frogs, leeches and fresh water sponges.

Selected histograms of population sizes can be seen in Figure 1. Large numbers of young hatch out in early June. Of those that survive, growth is most rapid before midsummer, but continues all during the growing season. Many animals die in situ when the water recedes, but others are still active in late August, crawling upon the mud and burrowing into it. The wide range of shell sizes present during the short growing season argues for the successful aestivation of individuals in all stages of growth.

Pacific Creek No. 2, Sec. 6, T45N, R113W, is an ephemeral pond which dries by mid-August. Meadow plants, predominantly *Conium maculatum*, sedges and grasses, grow up through the water to clothe it deceptively as a field. Once the water has evaporated, only the presence of dead shells and the stains of high water marks prove that water lay in the area. The vegetation protects all of the substrate except for a few bare patches of mud in the center.

This pond supports insects, crustaceans such as conchostracans, tiger salamanders and frogs. Waterfowl nest in the reed clumps. Twelve species of mollusca are found in Pacific Creek No. 2. *Helisoma subcrenatum disjectum* is the most abundant and a fairly large number of *Stagnicola palustris* is present. The other species formed a minor portion of the fauna. Only one individual of the clam, *Sphaerium striatinum*, was found.

Aestivating mollusks are mainly found in the central patches of bare mud. Although the mud became deeply cracked in late August of both years, it remained slightly damp three inches and more below the surface crust. Figure 1 shows details of population composition for *Helisoma subcrenatum*. Here again individuals of all sizes could be found throughout the summer.

Pacific Creek pond No. 1, same locality, lies over the ridge from No. 2. It is the only pond with a tan colloidal muck bottom. The pond surface is completely covered with marsh trefoil, *Menyanthes trifoliata*, so that it appears as a lush green meadow. The bulbous plant roots with their filamentous rootlets and the decaying vegetation create a fibrous mat interspersed through the ooze. A pole can be forced down more than 3 feet through the root matting to firmer bottom. To walk in the pond is im-

possible until the surface water evaporates.

When the pond dries, the mollusks retreat to the moisture below. There was no surface water in evidence by August 4, 1960, and the bottom had dried firmly enough to support the weight of an adult. The following year surface water disappeared by August 10 after an early and wet spring. *Helisoma subcrenatum disjectum*, the dominant species, can be found aestivating 6 inches and more below the surface. The other snails and clams are largely found around the perimeter of the pond in the thick growth of sphagnum moss. As the water recedes, land snails as *Vertigo ovata*, *V. gouldi coloradoensis*, *Pupilla hebes*, *Vitrina alaskana* and *Catinella wandae* invade the damp moss and mingle with the freshwater forms.

Since the population size analysis of *Helisoma* from this pond is similar to that reported from Pacific Creek No. 2, it is not shown. A small population of 11 other species of freshwater mollusks is present in this pond, as may be seen from Table 1.

Moose Pond, Sec. 19, T45N, R114W, holds a large population of *Stagnicola palustris wyomingensis* and *Sphaerium lacustre rykholti*. Five other species in the pond occur in fair numbers. The largest individuals of *Stagnicola*, and these with badly eroded shells, congregate in deep water along the east shore. The other animals are rather evenly scattered along the shore of the pond. Fewer animals, and these only adult forms, scavenge more widely in mid-pond. Population sizing of *Stagnicola* over two seasons showed that all sizes of individuals are present at all times in the pond.

Pond No. 4, Sec. 15, T45N, R114W, is a shallow depression in an aspen grove. A small population of *Sphaerium lacustre rykholti*, *Stagnicola palustris* and *Planorbula christyi* remain active until the water evaporates the latter part of July.

Pond No. 7, Sec. 23, T46N, R115W, a perennial water body, contained only *Pisidium compressum*. Taylor has indicated that this species is restricted to permanent waters. A thin crust of salt has been deposited over the thick muck and heavy algal growth around the pond's perimeter.

Pond No. 10, Sec. 23, T46N, R115W, fits into the general pattern of the ponds with its ring of aspen, some willows and sedges. It is shallow except for 3 holes in the center that are two feet below the general level. It dries completely during July, and al-

though it supports a few frogs and water insects, it has no mollusks.

Gros Ventre Pond, Sec. 2, T42N, R114W, near Slide Lake, was seen but once and is included in this report only as an example of the build-up of a population under severely limiting ecological factors. It is a small pond, one of a chain, that lies along the flood plain of the Gros Ventre River rather than in the pine forest. The water is highly alkaline, with a pH reading of 7.8, and has deposited a crust of salts around the perimeter of the pond. Huge numbers of the tiger salamander, *Amblystoma tigris* and *Stagnicola palustris* live in the pond. The snails crawl over the alkali flats in such numbers that the movements of the pneumostomes result in an easily audible clicking. Other than 5 individuals of *Physa skinneri* found during seining operations, this was the only mollusk present.

CONCLUSIONS

A total of 21 molluscan species are found in the 10 ponds. Field notes of the author indicate that these species habitually occur in ephemeral pools, sloughs, marshes and quiet perennial water. This agrees with the findings of Taylor who has listed the ecological requirements of these species as varying from temporary ponds to quiet stagnant water (perennial). The presence of *Valvata lewisi* in Pacific Creek No. 2, a temporary pond, was unexpected. This species is supposedly restricted to perennial waters.

In a study of the population of *Sphaerium partumeium* in an ephemeral pool near Ann Arbor, Michigan, Thomas found that it was primarily carried from year to year by young individuals. Very few sub-adults were able to survive the rigors of a severe habitat over winter. In these ponds around Jackson Lake it appears that individuals of all growth stages must overwinter to account for the wide range of shell sizes present during the growing season.

BIBLIOGRAPHY

- Beetle, D. E., 1957. Nautilus 71 (1): 12-22.
Reed, J. F., 1952. Amer. Mid. Naturalist 48 (3): 700-729.
Taylor, D. W., 1960. Geological Survey Professional Paper 337.
Late Cenozoic Molluscan Faunas from the High Plains.
Thomas, G. J., 1963. Nautilus 77 (2): 37-43.
Tuthill, S. J., and Laird, W. M., Nautilus 77 (3): 81-90.
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BATON ROUGE GREENHOUSE GASTROPODS

By PAT W. HERMANN, BENNIE C. STRICKLAND,
DEE SAUNDERS DUNDEE

In our continuing attempt to determine the distribution of introduced mollusks in the Gulf Coastal area, a survey of Baton Rouge greenhouses was made during May and June, 1964. It revealed the presence of 22 species of gastropods of which 3 species are introduced forms. Dundee and Watt (1962) collected 21 species of snails and slugs from New Orleans greenhouses including 6 species of introduced mollusks.

Three introduced species, *Lamellaxis gracilis*, *Gulella bicolor*, and *Vaginulus* sp. were found in both New Orleans and Baton Rouge greenhouses while *Subulina octona*, *Bradybaena similaris*, and *Veronicella floridana* were only in those of New Orleans. Although *Bradybaena similaris* was not found in Baton Rouge greenhouses, it is present in this city.

In order to determine if there was a correlation between the presence of introduced forms in a greenhouse and the source of their plant material, some of the greenhouse owners or managers were asked if they had received any plants from out of Louisiana. With reference to Table 1, greenhouse B received plants from Florida and Texas, C from Florida, California, Mississippi, and Alabama, D from Miami, Florida and The Netherlands and M receives cacti from our southwestern states. A, G, I, L dealt only within Louisiana. Those not mentioned were not asked about their plant sources.

It is of interest to note that *Vaginulus* sp. was found in greenhouses B and D both of which receive material from Florida. *Gulella bicolor* and *Lamellaxis gracilis* were also found at D giving a possible Florida link but *L. gracilis* was found at A which does not receive out of state material.

The owner of greenhouse C said that he thinks he has seen snails on plants coming from California but added that plants are dipped upon arrival.

Most of the owners or managers said that they had little or no trouble with snails and slugs damaging their plants. At greenhouse A, *Vaginulus* sp., *Mesodon thyroidus* and *Limax marginatus* were in fair abundance but appeared to be confined to the ground under the raised benches. This area was littered with boards, pots, cardboard and supported sufficient plant growth to

Table 1
Baton Rouge Greenhouse Gastropods

Greenhouse:	A	B	C	D	E	F	G	H	I	J	K	L	M
<u>Helicina orbiculata</u> (Say)	x												
<u>Polygyra septemvolva febigeri</u> (Bland)		x		x									
<u>Polygyra auriformis</u> (Bland)	x				x						x		
<u>Polygyra cereolus</u> (Muhlfeld)										x			
<u>Polygyra texasiana</u> (Moricand)						x							
<u>Mesodon thyroidus</u> (Say)	x					x		x				x	
<u>Mesodon perigraptus</u> Pilsbry	x			x									
<u>Lamellaxis gracilis</u> (Hutton)	x			x		x							
<u>Euglandina rosea</u> (Férussac)	x		x		x		x				x		x
<u>Retinella indentata</u> (Say)	x			x	x	x	x	x			x		x
<u>Hawaiiia miniscula</u> (Binney)	x					x						x	x
<u>Zonitoides arboreus</u> (Say)	x	x	x		x	x		x		x	x		
<u>Deroceras laeve</u> (Müller)	x	x	x			x	x						x
<u>Ventridens ligera</u> (Say)					x								
<u>Limax marginatus</u> Müller				x									
<u>Helicodiscus parallelus</u> (Say)						x							
<u>Succinea</u> sp.			x	x							x		x
<u>Succinea grosvenori</u> Lea								x				x	
<u>Succinea ovalis</u> Say									x	x			
<u>Vaginulus</u> sp.		x		x									
<u>Gulella bicolor</u> (Hutton)				x									
<u>Helisoma</u> sp. (imm.)	x												
<u>Physa</u> sp.					x								

provide an excellent habitat in which these animals were thriving. Perhaps this is why they were not bothering the commercial plant material kept on the benches.

A few owners seemed to have a little problem with gastropods and those at greenhouses B and M said that snails were particularly destructive to petunia plants. *Succinea* sp. were found crawling on petunias at B.

Although the consensus of opinions of the greenhouse operators is that snails and slugs generally don't cause much damage, most of these operators do use control measures. Among those mentioned were the commercial baits, Sluggit, Bug-Geta, Mala-

thion, Metaldehyde, Cygon, and Dieldrin. Karlin and Naegele (1958) state that Dieldrin and Endrin has been reported to kill slugs but experiments tend to give conflicting results and more tests must be made to determine their actual effectiveness.

All the greenhouses visited are sprayed regularly with Heptachlor, an insecticide. Whether this is useful in mollusk control also was not determined.

LITERATURE CITED

Dundee, D. S. and P. Watt. New Orleans Greenhouse Gastropods with a List of Some Other Southern Snails. Proc. La. Acad. Sci. 25: 47-49, 1962.

Karlin, E. J. and John A. Naegele. Slugs and Snails in New York Greenhouses. Cornell Ext. Bull. 1004: N. Y. Coll. Agric., 1958.

NOTES ON ZONITIDAE

BY LESLIE HUBRICHT

GLYPHYALINIA ROANENSIS (H. B. Baker)

Retinella (Glyphyalis) cumberlandiana roanensis H. B. Baker, 1930, Proc. Acad. Nat. Sci. Philadelphia 82: 203, pl. 9, figs. 7-9.

I have seen no intergradation between *G. roanensis* and *G. cumberlandiana* either in the shells or in the genitalia; they should, therefore, be considered distinct species. *G. roanensis* is found within the range of *G. cumberlandiana* but I have not found them together. It ranges as far south as Grundy and Monroe Counties, Tennessee, and Graham and Macon Counties, North Carolina.

GLYPHYALINIA INDENTATA (Say)

Retinella (Glyphyalinia) indentata paucilirata (Morelet) H. B. Baker, 1930, Proc. Acad. Nat. Sci. Philadelphia, 82: 210, pl. 11, figs. 6-8.

Having dissected over 100 specimens from many localities, I find that there is no correlation between anatomical differences and shell differences. Animals like *paucilirata* may be found in shells like *indentata*, and vice versa. Most animals are intermediate. The two anatomies figured by Baker are those of two lots and are not characteristic of either shell form. Because of the absence of any real pattern to the variation, in either the shells or the animals, I do not believe that recognition of the subspecies *Glyphyalinia indentata paucilirata* is worth while.

GLYPHYALINIA SOLIDA (H. B. Baker)

Retinella (Glyphyalinia) cryptomphala solida H. B. Baker, 1930, Proc. Acad. Nat. Sci. Philadelphia, 82: 213, pl. 13, figs. 1-8.

Anatomical and shell differences are constant with no intergradation in the large amount of material examined, and *G. solida* should be considered a distinct species from *G. cryptomphala*. *G. cryptomphala* occurs within the range of the widespread *G. solida* but I have not found them together.

GLYPHYALINIA SCULPTILIS (Bland)

Retinella (Glyphyognomon) sculptilis subdola H. B. Baker, 1930, Proc. Acad. Nat. Sci. Philadelphia 82: 217, pl. 12, figs. 5-9.

Glyphyalinia sculptilis often becomes sexually mature when the shell has reached a size of about 5 whorls. At this time the flagellum on the penis is very small or wanting. As the shell and animal grow the flagellum grows until in shells with 6 to 7 whorls the flagellum becomes well developed. The subspecies *subdola* is based upon shells which have just reached sexual maturity.

MESOMPHIX CAPNODES (W. G. Binney)

Mesomphix cupreus ozarkensis (Pilsbry & Ferriss), 1946, Acad. Nat. Sci. Philadelphia, Monogr. 3, 2: 337-338, figs. 173g, 175.

Mesomphix cupreus miktus Pilsbry, 1946, Acad. Nat. Sci. Philadelphia Monogr. 3, 2: 339, fig. 173f.

The papillose spirals on the shell of *M. capnodes* are sometimes deciduous. The papillae are found only on very new shell. In a lot of *miktus* from Campbell Co., Tennessee, one specimen had had the shell broken. It had healed with a small piece of shell set below the general surface. There were papillose spirals on this small protected piece, but not anywhere else on any of the shells in the large lot collected.

The species of the subgenus *Omphalina* do not have the conspicuous differences in the genitalia which are found in section *Mesomphix* s. s. In both *M. capnodes* and *M. cupreus* the epiphallus is inserted near the end of the penis but emerges from the penial sheath near the middle of the penis. In specimens in which the penial sheath is tight, the epiphallus looks as if it were inserted in the middle of the penis.

PARAVITREA TRIDENS Pilsbry

Paravitrea capsella tridens Pilsbry, 1946, Acad. Nat. Sci. Philadelphia Monogr. no. 3, 2: 375-376, fig. 195c-d.

Paravitrea tridens is anatomically distinct from *P. capsella*

(Gould). It is probably more closely related to *P. reesei* Morrison.

VENTRIDENS EUTROPIS Pilsbry

Ventridens intertextus eutropis Pilsbry, 1946, Acad. Nat. Sci. Philadelphia Monogr. no. 3, 2: 470, fig. 255.

Ventridens eutropis is anatomically distinct from *V. intertextus* (Binney) and I have seen no intergradation in shell characters.

Pilsbry gave the type locality as "Cherry Valley," east of Watertown, Tennessee. But Cherry Valley is west of Watertown. It is known from Cheatham, DeKalb, Macon, and Wilson Counties, Tennessee.

VENTRIDENS VOLUSIAE (Pilsbry)

Ventridens intertextus volusiae (Pilsbry), Acad. Nat. Sci. Philadelphia Monogr. no. 3, 2: 471.

Ventridens volusiae has not been dissected; however, the shell differences are constant. It is a species of the St. Johns River Valley of northeastern Florida. It is known from Duval, Lake, St. Johns, Seminole, and Volusia Counties, Florida.

DISPERSAL OF AQUATIC GASTROPODS VIA THE INTESTINAL TRACT OF WATER BIRDS

By CHARLES R. MALONE

Department of Biology, Texas Technological College, Lubbock

The occurrence of gastropods in isolated bodies of water has interested biologists for many years. Most authors (e.g. Kew, 1893, Boycott, 1936 and Baker, 1945) agree that birds are primarily responsible for transporting snails overland. The usual assumption is that snails become attached to the external surfaces of resting or feeding water birds and can remain attached and viable for sufficient lengths of time to effect dispersal. Malone (1965) showed that this is possible and that water birds do provide an effective and readily available means of dispersal for fresh-water snails.

Seldom has the possibility of viable snails being carried in the intestinal tract of birds been considered. Pascal (1891) suggested that the egg masses of *Lymnaea auricularia* might pass through the tract of swans but apparently he did not actually recover eggs from the feces of the birds. Kobelt (1871) thought that snails might pass unharmed through birds. His suggestion was

tried by Bondesen and Kaiser (1949) with *Hydrobia jenkinsi*. They found that no snails passed unbroken through ducks.

My research was undertaken to determine if juveniles and adults or egg masses of *Physa anatina* and *Helisoma trivolvis* could be dispersed via the intestinal tract of birds. Both species commonly occur in isolated bodies of water in west Texas. Mallard ducks (*Anas platyrhynchos*) and killdeer (*Charadrius vociferus*) were considered as examples of agents transport.

This research was supported by National Institutes of Health Grant GM 11394-01A1. I am grateful to Vernon W. Proctor for giving helpful suggestions and to E. P. Cheatum for aiding in identification of the snails.

Methods and Results. Ducks were placed in wire cages and fed aquatic vegetation containing large numbers of snails and egg masses. Each bird ingested about 75 to 100 egg masses per meal. Estimates of the number of snails eaten per trial ranged from 50 to 200. After feeding, the birds and cages were inspected for adhering egg masses and snails. Brown wrapping paper was placed beneath the cages and the first several droppings passed by each bird were collected.

Feces were inspected with a dissecting microscope. Any egg masses or embryos found were placed in small dishes of water and *Chlamydomonas* sp. for observation. To provide for undetected snails, the feces were placed in jars of soil and water with *Elodea*. All cultures were placed in a 27°C light room. Controls treated similarly hatched within 5 or 6 days.

Five ducks were used for 47 trials with *Physa*. Only 2 intact egg masses were recovered from the feces. The first of these contained 17 embryos, none of which developed further. Seven eggs were contained in the second; 4 developed normally and hatched on the fourth day following recovery. Five juveniles were found in a gallon jar which had received feces 14 days earlier. These probably developed from an egg mass. Juvenile and adult snails were never found in the feces. Shell fragments were frequently seen indicating that most if not all had been crushed. Apparently the egg masses were usually broken and the embryos scattered during passage through the tract. Twenty-eight individual *Physa* embryos in various stages of development were recovered from feces. An attempt was made to culture these but none were viable.

Eight trials were made with ducks and *Helisoma*. Neither em-

bryos nor juveniles and adults were recovered from the feces. However, one snail was found in a culture of feces 23 days after passage. No other *Helisoma* were recovered from birds, suggesting that this individual was probably a contaminator.

Post mortem inspection of the intestinal tract of 10 ducks indicated where the snails were being killed during passage. The birds were fed vegetation with *Physa* each 15 minutes for one hour. Fifteen minutes after the last meal, they were killed. Material found in all portions of the tract was removed, inspected, and cultured.

Neither juvenile and adult snails nor egg masses were found past the gizzard. Portions of 4 egg masses containing 31 embryos were taken from the gizzard. None developed further. Only one snail was recovered from the gizzard. It was found just inside the entrance. The snail's peristome was damaged but the snail was living when recovered. However, it died within the following hour. Only shell fragments were found in the lower portion of the gizzard where grit is contained.

The only viable snails recovered from the dead ducks were found in the crop. Four juveniles and 9 egg masses containing 153 embryos were recovered. All the juveniles lived and 136 of the embryos hatched within 5 days.

Egg masses were mixed with zooplankton and fed to killdeer. Individual birds were placed in a cage consisting of two compartments. Each was fed in one compartment then moved into the next where feces were collected. Ten killdeer were used for 56 trials with *Physa* and 20 with *Helisoma*. Each bird ate 10 to 20 egg masses per meal. No juvenile and adult snails were fed nor were post mortem studies conducted with killdeer.

Feces collected from killdeer were placed immediately in well oxygenated water. This procedure was not possible with the bulky duck feces but did not hamper inspection of killdeer feces. Egg masses were quickly separated from the feces by gentle agitation, removed, and cultured in the same manner as those taken from ducks.

A total of 45 *Physa* egg masses were recovered from the feces of killdeer. Only 3 of these contained viable embryos. 17 of 26 embryos contained in the 3 egg masses hatched. Embryos contained in the remaining 42 egg masses were killed during passage. One hundred and thirty-two individual embryos from broken egg

masses were recovered, but as with ducks, none was viable.

Only 8 *Helisoma* egg masses were recovered from the feces of killdeer. None of the embryos contained in these developed. Thirty-seven individual embryos were found in the feces; none survived passage.

DISCUSSION

It seems unlikely that dispersal of *P. anatina* and *H. trivolvis* via the intestinal tract of birds is of much significance, particularly with the latter. Apparently the only important aspect of internal transport is the possibility of snails and egg masses being carried in a bird's crop. Ingested food is not exposed to significant digestion before it enters the gizzard. Thus, if snails and egg masses contained in the crop were vomited, they would be viable. Bondesen and Kaiser (1949) did not consider this possibility in their study of *Hydrobia jenkinsi*.

Although internal transport of snails by birds seems possible, external transport as demonstrated by Malone (1965), is a much more effective mechanism of dispersal. The passage of viable snails through birds is probably a matter of chance and appears to be a rare occurrence. On the other hand, snails frequently become attached to the surfaces of birds and the opportunities for dispersal are probably numerous.

The distance snails can be carried internally is limited by the time required for food to pass through the intestinal tract and also by the period that snails can survive within the tract. In this study, the last of an entire meal seldom required over 2 hours to be passed by either ducks or killdeer. Viable embryos recovered from feces had always passed within 30 to 45 minutes following ingestion. Thus, it is unlikely that embryos could survive a maximum passage of 2 hours.

Dispersal via the crop probably has significance only involving short distances. Unfortunately, the rate of passage of food from the crop of ducks is not known. However, only 3 of the 10 ducks killed had food in their crops 15 minutes after eating.

Snails adhering to the surfaces of birds are likely to be carried great distances. Sufficiently small snails can remain attached to birds indefinitely and the period that snails can survive out of water far exceeds their period of survival within the intestinal tract.

Fresh-water gastropods apparently have not acquired resistant

eggs to enable them to be dispersed via the avian intestinal tract. For aquatic organisms that are easily desiccated, this has proven to be a highly effective mechanism of dispersal. For example, Proctor (1964) found that the eggs of many crustaceans are sufficiently resistant to withstand passage through the intestinal tract of ducks. Apparently no selective advantage has been placed upon resistant eggs for snails since juveniles and adults can usually resist the amount of desiccation encountered during an overland journey.

LITERATURE CITED

- Baker, F. C., 1945. The molluscan family Planorbidae. The University of Illinois Press, Urbana. 233 p.
- Bondesen, Poul and E W. Kaiser, 1949. *Hydrobia (Potamopyrgus) jenkinsi* Smith in Denmark illustrated by its ecology. *Oikos* 1: 252-281.
- Boycott, A. E., 1936. The habitats of fresh-water Mollusca in Britain. *Jour. Anim. Ecol.* 5: 116-186.
- Kew, H. W., 1893. The dispersal of shells. Kegan Paul, French, Trubner, and Company Ltd. London. 291 p.
- Kobelt, W., 1871. Fauna der nassauischen Mollusken. *Jahrb. d. nassau. V. f. Nat.*, Wiesbaden: XXV-XXVI. 274 p.
- Malone, Charles R., 1965. Killdeer as a means of dispersal for aquatic gastropods. *Ecology* 46: (in press).
- Proctor, Vernon W., 1964. Viability of crustacean eggs recovered from ducks. *Ecology* 45: 656-658.

NOTES AND NEWS

RUTH INGERSOLL BAILY died suddenly January 11, 1965. She was born in Montrose, Colorado, but at an early age, her mother took her to San Diego, California, where she lived much of her life. She was an alumna of Mills College. She met Joshua L. Baily, Jr., on the beach at La Jolla, where they both were collecting shells. They were married in San Diego, Feb. 19, 1917. Mrs. Baily was a member of the Society of Natural History of San Diego, the Historical Society of San Diego, many other San Diego organizations, the Mills College Club, the Academy of Natural Sciences of Philadelphia, the American Malacological Union, etc. As joint author with Dr. Baily, she published several papers on mollusks. All who knew Ruth will miss her keenly, and she still lives in our memories. — EDITORS.

ALEXANIA REPLACES HABEA (EPITONIIDAE) — A genus was discovered at three widely separated localities, and each time was newly described and named and placed in a different one of the three subclasses of Gastropoda. Robertson & Oyama [1958, Nautilus 72 (2) : 68-69] reported that *Stenacme* Pilsbry, 1945 [Nautilus 58 (4) : 112-116, pl. 5], type-species *S. floridana* Pilsbry (southeast Florida), is a synonym of *Habea* Kuroda, 1943 [Japanese Journ. Malac. (Venus) 13 (1-4) : 11-14, fig. 1], type-species *H. inazawai* Kuroda (southern Japan). Pilsbry wrongly placed *Stenacme* in a new family Stenacmidae, placing this next to Amphibolidae (subclass Pulmonata). Kuroda [1943], and also Habe [1943, Japanese Journ. Malac. (Venus) 13 (1-4) : 65-67, figs. 1-6], correctly placed *Habea* in Epitoniidae (subclass Prosobranchiata). Subsequently, Habe [1961, Venus 21 (4) : 417, 423] has described a third species, *H. callizona* (southern Japan).

One of us (T.H.) has discovered an older name for the genus than *Habea* Kuroda [1943]: *Alexandria* Tomlin, 1926 [Ann. Natal Mus. 5 (3) : 287-288, pl. 16, figs. 1-2], type-species (monotypy) *A. natalensis* Tomlin (12 mi. S.W. of Durban, South Africa). The description and figures of the shell and radular teeth of *Alexandria* agree in every respect with our observations of *Habea*. Unfortunately, *Alexandria* Tomlin [1926] is a homonym (non Pfeffer, 1881 [Echinoidea]). Embrik Strand, who studied homonymy to the neglect of synonymy, renamed *Alexandria* Tomlin twice, first as *Alexania* [1928 ("1926"), Arch. Naturgesch. 92A (8) : 63], seemingly the correct name for the genus, then as *Tomlinula* [1932, Folia Zool. Hydrobiol., Riga, 4 (2) : 193], an objective synonym [Pilsbry, 1933, Nautilus 47 (1) : 35-36]. Tomlin tentatively placed *Alexandria* (= *Alexania* Strand) in Acteonidae (subclass Opisthobranchiata), where it was retained by Thiele [1931, Handb. syst. Weichtierkunde 1 (2) : 380] and Zilch [1959, Handb. Paläozool. 6 Gastropoda 2—Euthyneura (1) : 10, fig. 21 (*Stenacme* Pilsbry p. 80, fig. 260)].

While a participant in the International Indian Ocean Expedition (U. S. Program in Biology), one of us (R.R.) studied an *Alexania* at Mandapam Camp, on the coast of the Gulf of Mannar, southeast India. Shells of all species in the genus are less than 10 mm. long, elongate-ovate to globose, with inflated whorls, an impressed (slightly channeled) suture, a fairly thin periostracum, and a fragile, styliform protoconch. The thin shells are dark

brown to pale brownish yellow or have variable brown bands on white; the surfaces are smooth except for axial growth lines, and (commonly indistinct) low axial blades on spire reminiscent of *Epitonium*. Thus, the shell is not particularly distinctive, and resembles those in some widely unrelated genera—such as *Viviparus*, *Lacuna*, *Problitora* and *Algamorda* (both Littorinidae?), various Assimineidae, *Halotapada* (Fossaridae?), *Salinator* (Amphibolidae), and various Lymnaeidae.

The ecology and anatomy of *Alexania* are, however, distinctive, and show that the genus does belong in Epitoniidae. All the known species occur on subtropical and tropical continental shores. They probably all live intertidally on sand-scoured rocks with sea anemones (Actiniaria), on which they feed (compare other Epitoniidae [Robertson, 1963, Proc. Malac. Soc. London 35 (2-3) : 51-63, pls. 5-7]). Their appearance is seasonal, and small to dwarf males occur with the females. Pairs commonly are found with masses of *Epitonium*-like, sand-agglutinated egg capsules. Pelagic veligers hatch from these. The hypobranchial gland secretes purple. Epipodium-like flaps extend from the foot on both sides and partly cover the shell. Even though not used to close the aperture, the horny, paucispiral operculum is large. The proboscis is thick, fairly short, and acrembolic, and the radula is ptenoglossate.

The Epitoniidae and Janthinidae are closely related. Shells of *Alexania* (Epitoniidae) and *Recluzia* (Janthinidae) are remarkably similar. However, *Recluzia* is larger, makes a bubble float, and seemingly is holopelagic.

The above information is recorded now, in advance of a monograph planned by one of us (R.R.) with the belief that *Alexania* can be found on shores between Florida, South Africa, India, and Japan. More comparative material is needed for study. Possibly, one of several variable, circumglobal species are involved (compare *Janthina* and *Recluzia* [Laursen, 1953, Dana-Report 6 (38) : 1-40, figs. 1-41, pl. 1; Abbott, 1963, Nautilus 76 (4) : 151]). — ROBERT ROBERTSON & TADASHIGE HABE.

MONOMPHALUS (PUNCTIDAE) — According to article 69 (a) (iv) of the 1961 "code," the type species of *Monomphalus* Ancey, 1882, is *Helix heckeliana* Crosse, 1872, of New Caledonia. Actually, Pilsbry, 1893, Man. Conch. (2) 9: 19, selected *F [lammulina]*

rossiteriana (Crosse, 1871) but (p. 20) synonymized it and *heckeliana* (a substitute) "at the same time." Solem, 1961, *Fieldiana: Zoology* 41: 464, subsequently designated *Helix bavayi* Crosse and Marie, 1868. — H. B. B.

NOTES ON LAND SNAIL DISTRIBUTION IN TEXAS — This note reports new county records for land Pulmonata in Texas. Only the county is given for common, widespread forms. Catalogue numbers are those of the author.

Philomycus carolinianus flexuolaris Raf. Four specimens (265) were collected in the bottoms of the Sabine River just downstream of Lake Tawakoni, Rains County. One specimen (909) was collected in the Sam Houston National Forest, in southern San Jacinto County. *Anguispira alternata crassa* Walker. Seven specimens (910) were collected in the Sam Houston National Forest in Southern San Jacinto County. *Limax flavus* Linnaeus. Tarrant County (702). *Mesomphix friabilis* (W. G. Binney). Cass County (705). *Rumina decollata* (Linnaeus). Menard, Menard County around ruins of Mission San Saba (955).

Euglandina texasiana (Pfr.). The only published Texas records are from "Brownsville." During August, 1962, and January, 1964, specimens were collected in Southmost Palm Grove (558, 814, 818) and Rabbs Palm Grove (563) southeast of Brownsville; in the Arroyo Colorado (living material, not drift) at Harlingen (571); west of Bayview (565); and at Highland School 5½ miles east and 4½ miles north of Los Indios (821) all in Cameron County. In Hidalgo County specimens were found at Santa Ana National Wildlife Refuge (557) and at the Las Palomas Wildlife Management Area south of Madero (824).

Bulimulus dealbatus ragsdalei Pilsbry. Western Travis County (486); McCulloch County, collected by G. V. Oliver (747); Hood County, collected by R. L. Lardie (WLP 782); Palo Pinto County (894, 943, 1005); Wise County (WLP 974); Erath County (984). Intergrades with *B.d. mooreanus* were collected in northwestern Tarrant County (837); and in Parker County, collected by R. L. Lardie (872, 873, 874).

B. alternatus mariae (Albers). Kenedy County, eleven miles south of Sarita (811). *B. schideanus pecosensis* Pilsbry & Ferriss. Kimble County, twenty miles west of Junction, collected by G. V. Oliver (1049). *Triodopsis vultuosa copei* (Weatherby). Mont-

gomery County (WLP 186, 900); San Jacinto County (913). *Stenotrema leai aliciae* (Pilsbry). Montgomery County (187, 898); Liberty County (904); San Jacinto County (911); Gonzales County (WLP 494, 500); Wise County, collected by B. E. Dial and J. Glidewell (975). *S. leai* subsp. Hemphill County at Lake Marvin on the North bank of the Canadian River eleven miles east of Canadian. In a relict area of deciduous forest (279). *Polygyra auriformis* (Bland). Hays County, near Wimberly (532); Gonzales County at Palmetto State Park (501). *P. t. texasiana* (Moricand). Hunt County (263); Hopkins County (343); Palo Pinto County (942); Taylor County, non-fossil material, collected by G. V. Oliver (749). *P. dorfuelliana* Lea. Hood County (53); Palo Pinto County (944, 993); Parker County (251). — W. L. PRATT, JR., 4501 El Campo, Ft. Worth, Texas 76107.

CARNIVOROUS HABITS IN *MESODON INDIANORUM* (Pilsbry) — On 9 March 1963, I collected a number of *M. indianorum* (Pilsbry) [= *M. binneyanus*] at Beaver Bend State Park, McCurtain County, Oklahoma. Three of these were maintained alive in a terrarium along with *Triodopsis albilabris* and *Anguispira alternata*. On 14 May 1963 at about 8:00 P.M., a specimen of *Bulimulus dealbatus* was added to the terrarium. At 10:00 P.M. the largest *Mesodon* was found to have consumed the foot and part of the mantle of the *Bulimulus* which was completely consumed by 11:30 P.M. A literature search has yielded no previous records of carnivorous habits in the family Poligyridae. The *Mesodon* is No. 732-a in my collection. — W. L. PRATT, JR., 4501 El Campo, Ft. Worth, Texas 76107.

ADDITIONAL LOCALITY FOR *MESODON KIOWAENSIS* — Branson (Proc. Okla. Acad. Sci. 42: 60-80) mentions that about 20 specimens of *M. kiowaensis* (Simpson) are known. On 8 July 1962, I collected 2 adult and 5 immature shells in all growth stages from under a single log 4 miles northwest of Mount Ida, Montgomery County, Arkansas. The specimens are No. 317 in my collection. — W. L. PRATT, JR.

SINISTRAL *MESODON ROEMERI* — On 31 October 1964, a sinistral adult shell of *M. roemeri* (Pfr.) was collected in Possum King-

dom State Park, Palo Pinto County, Texas. This is apparently the first record of a reversed shell of this species. The shell is No. 992 in my collection. — W. L. PRATT, JR.

AN INTRODUCED SLUG NEW TO TEXAS — On 1 January 1965, I collected 10 adult specimens (No. 1041) of *Lehmannia poirieri* (Mabille) in the Botanic Gardens of Fort Worth, Texas. There does not appear to be a previous record of this European slug in Texas. — W. L. PRATT, JR.

THE 2ND EUROPEAN MALACOLOGICAL CONGRESS and Symposium on Malacology and Parasitology will be held in Copenhagen, Denmark, August 10 to 14, 1965. Those who wish to attend should notify them at Universitetsparken 15, Copenhagen ö Denmark, not later than May 1, 1965.

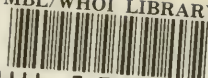
OCEAN SCIENCE AND OCEAN ENGINEERING CONFERENCE will be held at the new Washington Hilton Hotel, June 14-17, 1965, in Washington; D.C., sponsored by the Marine Technology Society and the American Society of Limnology and Oceanography. Capt. Jacques-Yves Cousteau, famed undersea explorer, will speak at the banquet meeting, June 15, at 7:30 P. M.

Albert B. Bronson, well-known collector and shell dealer on Guam Island, died of a heart attack at the age of 55, while walking on a beach near his home, on February 10, 1965. He was buried at sea on February 14.

PUBLICATIONS RECEIVED

- Altena, C. O. van Regteren. 1964. Notes sur les limaces. 9 Description d'une nouvelle espèce de *Deroceras* des environs de Grenade. Zoo. Mededeling. Rijksmus. Nat. Hist. Leiden 39: 45-47, pl. 8. — *D. hilbrandi* from Spain.
- Baker, H. Burrington. 1963. Type land snails in the Academy of Natural Sciences of Philadelphia. Part 2. Land Pulmonata, exclusive of North America north of Mexico. Proc. Acad. Nat. Sci. Philadelphia 115: 191-259. 1964. Part 3. Limnophile and thalassophile Pulmonata. Part 4. Land and fresh-water Prosobranchia. Proc. cit. 116: 149-193.

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